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REPORT OF

THE BUREAU OF MINES

1898

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Seventh Report of

The Bureau of Mines

In compliance with the direction of the Commissioner of Crown Lands, and with the approval of the Chairman of the Printing Committee of the Legislative Assembly, the Seventh Report of the Bureau has been brought out in Parts, with a view to secure early publication. Part I was issued under date of March 10, Part II under date of May 28, and Part III under date of August 19. These Parts, to the number of 1,000 copies, are now bound in one volume, with Contents and Index of the whole, for distribution in permanent form to libraries and technical journals, as well as to mine owners, mining experts and others interested in the mineral industries of the Province.

Statistics of the metalliferous mines and works of the Province have been collected for the first and second quarters of the current year, summaries of which have been published in the second and third Parts. The results are presented in the following table, together with the production for the twelve months of 1897 :

		1898. 6 mos.	1897. 12 mos.
Gold :			
Ore treated	net tons.	24,779½	27,589
Gold product	oz.	8,217½	11,412
Value of gold	$	133,744	190,244
Silver :			
Ore treated	net tons.	73	
Silver product	oz.	19,207	none.
Value of silver	$	10,632	
Nickel and copper :			
Ore smelted	net tons.	55,871	96,094
Matte product	"	9,779	14,034
Nickel in matte	"	1,226	1,999
Copper in matte	"	2,231	2,750
Value of nickel	$	235,763	359,651
Value of copper	"	141,744	200,067
Iron ore	net tons.	13,032½	2,763
Value at mines	$	23,845	4,689
Pig iron :			
Ontario ores	net tons.	9,215	2,770
Foreign ores	"	29,365	34,722
Mill cinder, etc	"	4,696	5,350
Pig iron product	"	25,423	24,011
Value of pig iron	$	305,083	288,128

Summarized by values, the statistics of the first six months of the current year and the twelve months of last year are as follows :

	1898. 6 mos.	1897. 12 mos.
Gold	$133,744	$190.244
Silver	10,632	.....
Nickel	225,763	359,651
Copper	141,744	200,067
Iron ore	23,845	4,689
Pig iron	305,083	288,128
Totals	840,811	1,042,779

For the six months of this year the value of products is four-fifths of the value for whole of last year.

ARCHIBALD BLUE,
Director.

Office of the Bureau of Mines,
Toronto, September, 1898.

REPORT OF
THE BUREAU OF MINES

VOL. VII 1898 PART I

Introduction

NO BETTER evidence can be given of increased activity in mining enterprise in the Province than is afforded by the grants of mineral lands by the Crown and the charters issued to mining companies during the year 1897. The total number of locations sold and leased in the year was 1,255, embracing an area of 115,809 acres, whereas for the five years 1892-96 the number sold and leased was 1,026, with an area of 93,821 acres. The revenue derived by the Crown last year from sales and rentals was $144,299, whereas for the preceding five years it was only $131,518. Adding the rentals of lands previously leased, the aggregate revenue of the five years was $146,959, while for 1897 it was $150,540, or, if the revenue from mining licenses be included, the aggregate for 1897 was $153,561. Equally significant was the activity shown in the incorporation of mining companies, as the following table of number of companies chartered with amount of their authorized capital for each year since Confederation will show :

Year.	No.	Capital.
1868	6	$658,500
1870	1	10[illegible],000
1871	1	40,000
1873	2	550,000
1874	3	1,800,000
1875	12	8,290,000
1876	1	800,000
1879	1	100,000
1880	4	480,000
1881	1	250,000
1882	8	4,552,880
1883	7	1,710,000
1884	3	2,750 000
1885	2	1,600,000
1886	3	1,060,000
1887	2	5,250,000
1888	10	1,368,000
1889	5	3,570,000
1890	14	2,755,000
1891	12	2,723,000
1892	14	4,025,000
1893	1	300,000
1894	5	2,135,000
1895	2	62,000
1896	26	15,600,000
1897	140	101,531,000

In four years of the thirty no charters were issued to mining companies, and the total number issued down to the end of 1897 has been 286, with an aggregate authorized capital of $164,060,380. To the end of 1896 there were issued 146 charters, with a total capital of $62,529,380, one-fourth of which is held by the 26 companies organized in the latter year. In 1897 the number of companies incorporated was only six less than in the preceding 29 years, but in amount of authorized capital they exceed all companies formed in the 29 years by $48,000,000. Of course every company that has secured a charter is not likely to become a working company, but out of so large a number there are no doubt many that will proceed to make investments of their capital both in the acquisition and the development of properties and the next year or two ought to show a large increase in the mineral productions of the Province.

There is room for large development in the mineral industries of the Province. Not only does the varied list include all of the principal and more commonly found metals, such as iron, copper, lead, silver and gold, but it also embraces the comparatively rare metal nickel, the deposits of which in the Sudbury district constitute one of the two sources of the world's supply. In the smelting of iron ore a fair beginning has been made, but the capabilities of expansion in this line have as yet been scarcely more than touched. The magnetite deposits of eastern Ontario and the hematite and magnetite of northwestern Ontario taken together are more than sufficient to supply our own needs in the way of iron for perhaps centuries to come Among the non-metallic substances we possess the basis of two permanent and important industries in our salt beds and petroleum wells. The whole shore of lake Huron from the latitude of Kincardine southward, and for many miles inland, is underlaid with beds of salt hundreds of feet thick, supplying the raw material not only for refined salt itself, but for carbonate and bi-carbonate of soda, soda ash, bleaching powder, and other essentials for the textile and other industries. The petroleum industry leads all others of a mineral nature in the value of yearly output, and affords an admirable example of what enterprise and skill can do in the profitable utilization of raw material. Another instance of this is seen in the cement business, which has undergone satisfactory development during the past few years. In the products of clay—brick, tile, terra cotta and sewer pipe—the output is limited only by the market. A new branch of the business has recently been established in the manufacture of paving brick. The use of this article for street purposes seems bound to be very extensive, now that Canadian makers have shown that the product of their kilns is comparable in quality with brick from the yards of Ohio and Illinois, besides being lower in price. Natural gas is a substance which in point of value stands high in the list of Ontario's mineral products, although it is to be regretted that so much of it is taken out of the country for consumption. In almost every one of the minerals here mentioned the opportunities for the profitable investment of capital are numerous, and the vivifying touch of enterprise and capital is alone wanted to call many other industries into being. There is abundance of raw material, cheap labor, large water privileges available for power, facilities for distribution by land and water, and safety of life and property, the only limit to development in some lines being the narrowness of the market. But in one branch of the industry, that of gold mining, there is practically no limit ; no civilized country builds or maintains a barrier to shut out gold. The free milling ores of northern and northwestern Ontario offer probably as fair a reward to the miner and capitalist as any ores in the world, and their extent and continuity admit of no doubt. A small pocket or a placer tract may soon be worked out, but a quartz vein of moderate extent may afford abundant material for a business man's lifetime. Such a vein crossing a location of 20 chains square or 40 acres, if four feet wide and worked to a depth of 500 feet, would furnish rock to supply a 10-stamp mill night and day and 300 days in the year for more than 30 years. A profit of $5 per ton would net a 10-stamp mill $30,000 a year, and there are many properties in the Lake of the Woods and Seine river districts which would approximate this standard with such a mill, after all allowance is made for irregularities in the size of veins and in the quantity of their ore contents. Such a business would be a permanent one, affording a constant market for labor and a steady return on invested capital long after the placer fields of more distant and inhospitable regions had been deserted as barren wastes.

In the month of June a Mining Lands Agency of the Crown Lands Department was opened at Rat Portage to receive applications for mineral lands in the Lake of the Woods district. This office has proved to be a great convenience to prospectors by the facilities it affords for carrying on business with the Department, and has also served a good purpose in relieving the pressure of work at the head office. Maps upon which are laid down all locations applied for and locations for which

patents or leases have issued are kept for the purpose of reference, together with a register of every transaction, so that information may be promptly given to explorers and others regarding any property in the district. All official papers, affidavits, etc., relating to lands applied for, however, are forwarded to the head office for ruling by the Commissioner, who has sole authority to decide disputes and order titles to issue. From the opening of the Rat Portage office until the end of the year 501 applications were received, but in some cases one application covered several locations, and on account of these there was received and paid through the office the sum of $5,932.57.

After having been held in abeyance for more than a quarter of a century the part of the Mines Act which relates to the staking out and working of mining claims by licensees was brought into operation last year in a portion of the Province lying east and north of lake Superior. The report that promising discoveries of gold had been made in the basin of the Michipicoton river induced the Government to make a trial of the mining claims system, and accordingly on the 9th of September an Order in Council was passed whereby the Michipicoton Mining Division was established, and on the 15th of the same month Regulations based on the Mines Act were approved by His Honor the Lieutenant Governor for use in Mining Divisions. The Michipicoton Division has for its southern limit the latitude of Cape Gargantua on lake Superior, 47° 36′ north, for its eastern limit the meridian of the east end of Dog lake, or about 84° west from Greenwich, for its northern limit the parallel of 48° 30′, and for its western limit the shore line of lake Superior between the above lines of latitude. The total area is computed to be about 5,000 square miles. An Inspector was appointed for the Division, who opened an office at Michipicoton Post for the transaction of business on the 23rd of September, and remained there until the close of navigation on the 1st of Novemter. The total number of miners' licenses issued for the Division from the date of its establishment to the end of the year was 250, and the number of mining claims staked out and recorded during that time was 225. The revenue of the office from licenses, fees on additional claims taken up and other fees, was $3,021.

Several amendments to the Mines Act were suggested by the experience of the office at Michipicoton Post, and in the last session of the Legislature an Act was passed to give effect to them. Revised and amended Regulations, embodying the changes made by the Act, were approved by His Honor the Lieutenant Governor on the 29th of January, and these are now in force in the Michipicoton Division. The more important alterations relate to the granting of licenses, the size of claims, the performance of working conditions, and the acquisition of permanent title when the working conditions have been fulfilled. Any person, registered partnership, or mining company incorporated under the laws of the Province may procure a yearly license to explore any portion of the Mining Division and stake out and work a claim therein upon payment of a fee of $10, and the license is renewable upon payment of the like fee and production of proof under oath that the mining conditions have been duly performed upon the claim or claims staked out and held by the licensee. A claim may be of 15 chains or 990 feet square, horizontal measurement, containing 22½ acres, or of other extent greater or less according to the nature of the ground, not to exceed a square of 20 chains or 1320 feet containing 40 acres; but an irregular portion of land lying between two or more claims may be staked out with boundaries conterminous thereto, provided that its area shall not exceed 40 acres. The boundary lines of a claim on the surface are required to be laid out north and south and east and west astronomically, and where there are standing trees on the claim the licensee is required to blaze the trees and cut the underbrush along the boundary lines and from the first corner post to the discovery post. A claim under the surface of the ground is deemed to be bounded by lines vertical to the horizon. No more than one claim may be staked out by a licensee upon the same vein, lode or deposit of ore or

mineral unless it is distant at least 60 chains from the nearest known mine, claim or discovery on the same vein lode or deposit, and no licensee may stake out and record more than four claims within a radius of 15 miles in one calendar year. For each additional claim after the first that has been staked out and recorded a fee of $10 a year is levied if the area is more than 15 chains square, and $6 if it is 15 chains square or less. A licensee who stakes out a claim is required within 30 days to file a record of it under oath in the office of the Inspector for the Division. It is this officer's duty forthwith to enter the particulars in a record book, and if there is no dispute by reason of prior discovery or otherwise he may at the expiration of ninety days grant to the licensee a certificate of the record. Actual mining operations are required to be carried on by each licensee upon each claim held by him for at least five months of one man's time in every calendar year, or an equivalent if more than one man is employed; but for every four claims or less held by the same licensee or by different persons agreeing to combine their mining operations within a radius of one mile, all the work may be expended upon one of the claims. No payment of money is accepted in lieu of working conditions, and no improvements such as roads or buildings; nothing else can be substituted for "actual mining operations," and in each calendar year five months or 130 days of one man's labor is demanded by the Regulations, or the equivalent of that time if two or more men are employed on the claim. Should the licensee desire to secure a more permanent title to his claim than occupation or the Inspector's certificate affords, provision is made in the Regulations for obtaining a patent or lease. If the working conditions have been complied with for a period of three years on a claim of 20 chains square, or of two years on a claim of 15 chains square or less, or an equivalent in a less period of time if more than one man is employed, the licensee may apply for and obtain a patent or lease of the land embraced in his claim upon a survey being made and filed in the regular way and upon payment to the Crown of the purchase price or first year's rental at the rates provided in the Mines Act. The claim may then be held free from further working conditions, but not otherwise.

The Journal of the Royal Colonial Institute published in its February number of this year a paper on the Goldfields of Ontario and British Columbia which was read at a meeting of the Institute on January 11 by one Edgar P. Rathbone, M. Inst. M. M., A. M. Inst. C. E., M. I. Mech. E., who visited Canada last year. The Right Hon. Lord Strathcona and Mount Royal, High Commissioner for Canada, presided, and among others who were present and spoke in laudatory terms of the paper were Right Hon. James Bryce and Hon. F. W. Borden, the Canadian Minister of Militia. There was little in the paper which any well informed Englishman might not have written without leaving his own home, but it contains a number of statements which no intelligent and careful man could have written who had taken ordinary pains to inform himself.

Mr. Rathbone says in his paper that the mining laws of Ontario are greatly inferior to those of British Columbia, "owing to the introduction of certain measures whereby the genuine mining prospector is placed at a distinct disadvantage." By this, as subsequently qualified, he meant only that the prospector is obliged to hand to the Government a survey which costs a good deal of money—Mr. Rathbone thinks about a dollar an acre. But this is mere guess; and all depends on where the location is. If in a surveyed district the prospector has nothing to pay, and if in an unsurveyed district the lower price of the land is supposed to make good the cost of survey. In the Crown Lands Department the average cost of a survey is assumed to be fifty cents per acre; but of course it may be more if the distance is far to the location. The difference in price between a mining lot in a surveyed township within six miles of a railway and a lot in unsurveyed territory more than six miles from a railway is one dollar per acre; and so the prospector is placed at no disadvantage. But if the objection be that the prospector is obliged to make his survey at too early a period of the mining work, the answer is

that he does so to acquire his patent for the location. Then it is entirely his own, to work it or to sell it, and surely this is not a disadvantage to him. Under the British Columbia law the prospector is also required to survey his claim of 50 acres, and can only get a title at the end of five years and the expenditure of $500 in developing a mine upon it. But if he is a wealthy man he may become entitled to a Crown grant upon payment of $500 to the Government in lieu of any expenditure upon the claim

Then Mr. Rathbone assumes that there are no working conditions attached to the holding of mineral land in Ontario. "This is the case in British Columbia," he says, "but in Ontario, after making a costly survey, large blocks of claims are held by the payment of a small sum and no work is necessarily done, so that prospecting work is in a very backward condition." Evidently he has not taken the trouble to know what the Ontario law is. Section 34 of the Mines Act requires that during the seven years immediately following the issue of the patent the grantee of a mining location shall expend in actual mining operations, exclusive of all houses, roads and other like improvements, a sum not less than at the rate of $1 per acre during the first two years, and of $1 per acre during each remaining year of the seven years, computed at the rate of $2 per man per day; and in default of such expenditure in any year all his rights to the location revert to the Crown. Working conditions were provided for in the Act of 1891 at a rate of $5 per acre on every location of 160 acres or less, to be expended during the seven years immediately following the issue of the patent, and these conditions must be carried out during the present year on lands granted in 1891 if for any cause the work has not already been done. The amendment made to the Mines Act last year requires a larger expenditure for mining operations, and a fixed amount annually after the first year, amounting in all to $6 per acre in the seven years, being $240 on 40 acres, which is the smallest area that can be taken up as a mining location. And it may be stated that a larger area of mining lands was granted in the Province last year than in the preceding five years, although the amended Act provides that no man can take up more than 320 acres within a radius of 15 miles in any one district or county. As a matter of fact the average area of all mining locations sold and leased in the past seven years has been only 103 acres; and so there is no ground for the sweeping statement that large blocks are held by the payment of a small sum and no work done.

But under the provisions of the Ontario Mines Act for the staking out of mining claims, which are in force over an area of 5,000 square miles in the Michipicoton Mining Division, the working conditions are more exacting than in British Columbia. There every licensee who has staked out a claim is required to put upon it five months of actual mining work in each year. Before he can apply for a patent he must show that on a claim of 15 chains square, or 22½ acres, he has expended 10 months of one man's labor, which at $2 per day is $520; and if the claim is 20 chains square, or 40 acres, he must show that he has expended 15 months of one man's labor, or $780. The Ontario law also requires that claims be staked out with astronomical boundary lines of north and south, and east and west, thus lessening the chance of disputes between adjacent claim holders.

Leaving the subject of mining laws, Mr. Rathbone has much to say in praise of the method of mineral statistics in operation in the Transvaal, where he seems to have been employed under President Kruger, and he makes the following statement on the inefficiency of the method in operation here (the italics being his own): "In order to illustrate the injury which may be done to a mining community, and indeed to the State at large, through the *non-enforcement of statistical information* by the Government from mine owners, I may here state that at the present time the largest gold-producing mine in the Province of Ontario, being a private venture, does not make any public returns of its gold production, nor indeed is it possible to obtain any statistical information as to what the undertaking is; so that what might have acted as a valuable object lesson in connection with the mining in that district is entirely lost to the whole

community." This can only refer to the Sultana mine, the owner of which is Mr. John F. Caldwell. The provisions of the Mines Act do not distinguish between private ventures and company ventures in the furnishing of statistical information. The owner or agent of every mine is required to send to the Bureau of Mines on or before the 15th of January, a correct return for the year ending the preceding 31st day of December of the men employed at his mine and works, the average rate of wages paid to them and the total amount paid during the year, together with the quantity of the mineral which has been sold, treated or used during the year, and the value or estimated value thereof. And in addition the owner or agent of every metalliferous mine may be required to make similar returns at the end of each month or quarter in order that the same may be tabulated for publication. Now, Mr. Caldwell has never refused to supply such information to the Bureau. The statistics of his mine have been furnished regularly every year with as much promptness as those of any mine in the Province, and no statement of the gold product of the Province has been published since the mill of the Sultana mine was started five years ago which did not contain the statistics of that mine. It is true that they have not been published separately, but neither have those of any other mine or works in the Province. The time for that has not come yet.

One other statement made in Mr. Rathbone's paper is that "The Dominion Government should in any case have a separate office to collect all the mineral statistics from the various Provinces in one statement, as under the present arrangement it is difficult to ascertain what the total annual production of gold and other minerals amounts to." This is in connection with a reference to the work of the British Columbia and Ontario Bureaus, and an ill-concealed sneer at the latter. Mr. Rathbone apparently does not know that the Dominion Government already has an office for the collection of mineral statistics from all the Provinces, although that office was established by the Geological Survey years ago and has published statistical of the mineral production of the Do every year since.

As already intimated, Mr. Rathbon a visit to Canada last year, and in the of June he was present and spoke at a Convention at Rat Portage. Altho had then been in the district but three days, he condemned the Gover of Canada and Ontario because they h nothing for the miner, he condemi mining laws of Ontario and its sy mineral statistics, he condemned the mine and its management although only seen it for half an hour along crowd of a hundred or more other peo was not allowed to descend the shaft, demned the timber of the country as for fuel, he condemned everything water. The writer of this note was on that occasion, and being invited t he replied to Mr. Rathbone ; but th read before the Royal Colonial Inst January shows that Mr. Rathbone profit by what he heard in June.

It has never been the practice of this to notice the comments or criticism either upon its own management, or u mining laws of the Province, or up value of our mineral resources ; and comments have sometimes been made upon one ground or another which w always considerate or fair. This rec stance however appears to justify a de from the rule hitherto observed, not any importance is attached to Mr. Ra or the many titles appended to his na because of the place in which the pa read and of the distinguished men w present to hear it. A man who is eit an honest critic, or who will not quali self by information to express an int criticism, no matter what his profess attainments may be, is not one to be de on as counsellor or guide in the b affairs of men. A

Statistics of Mining Lands and Minerals

Mining Companies

ONE of the striking evidences of the interest shown in mining enterprise in Ontario is the number of companies that are being organized for mining purposes. In the list which follows are the Companies to which charters have been granted in Ontario for the last thirty years, with the dates of their incorporation and the amounts of their authorized capital.

Mining Companies Incorporated since 1867

Name of Company.	Date of Charter.	Capital.
The Anglo-Saxon Gold Mining Company	March 9, 1868..	$ 125,000
The Angus Islets Silver Mining Company	Sept. 5, 1874..	1 000.000
The Artikameg Prospecting, Mining and Lumbering Company.	July 1, 1875..	100,000
The Arthur Mining Company of Ontario	Feb. 28, 1884..	750,000
The Alpha Oil, Gas and Mining Company of Ontario, Limited.	Aug. 22, 1885..	1,000,000
The Algoma Mineral Land Company, Limited	Dec. 19, 1888..	200,000
The Algoma Gold Mining and Reduction Company, Limited	June 30, 1890..	500,000
The Algoma Copper Mining Company, Limited	March 31, 1896..	1,000.000
The Algoma Coal Mining Company, Limited	Dec. 30, 1896..	1,000,000
The Atlas Gold Mining and Development Company of Rat Portage, Limited	Jan. 20, 1897..	90,000
The Attercliffe Station Natural Gas Company, Limited	March 8, 1897..	2,000
The Anglo-Ontario Exploration and Gold Mining Company, Limited	March 15, 1897..	1,000,000
The Ambrose Mine and Development Company, Limited	March 19, 1897..	1,000,000
The Algonquin Gold Mining and Development Company, Limited	March 23, 1897..	1,000,000
The Assaying and Smelting Company of Ontario, Limited	April 17, 1897..	75,000
The Aurora Mining and Development Company of Ontario, Limited	April 14, 1897..	1,000,000
The AD2 Gold Mining Company of Ontario, Limited	Aug. 19, 1897..	500 000
The Atkinson Marble and Granite Company of Simcoe, Limited	Oct. 6, 1897..	20 000
The Beaver Mining and Milling Company of Ontario	Nov. 6, 1886..	1,000,000
The Bedford Mining Company	Sept. 8, 1887..	250,000
The Bancroft Iron Company, Limited	Sept. 12, 1889..	1,000,000
The Belmont Bessemer Ore Company, Limited	April 17, 1891..	600,000
The Bonanza Nickel Mining Company of Sudbury, Limited	May 6, 1891..	150,000
The Badger Silver Mining Company of Gillies, Ontario, Limited	June 20, 1891..	250,000
The Bullion Mining Company of Ontario, Limited	Feb. 18, 1893..	300,000
The Bath Island Mining Company, Limited	Mar. 3, 1897..	750,000
The Black Sturgeon Mining Company of Ontario, Limited	Mar. 1, 1897..	1,000,000
The Bald Indian Bay Mining and Investment Company, Limited	Feb. 15, 1897..	6,000
The Burley Gold Mining Company of Ottawa, Limited	Feb. 15, 1897..	1,000,000
The Bi-Metallic Mining and Development Company of Ontario	April 7, 1897..	2,000,000
The Bannockburn Gold Mining Company, Limited	April 17, 1897..	500,000
The Canadian Mineral Company	May 18, 1870..	100,000
The Canada Silver Mining Company	May 29, 1874..	500,000
The Canada First Silver Mining Company (Name since changed to The Native 7 Silver Mining Co)	Oct. 27, 1875..	240,000
The Calabogie Mining Company, Limited	May 1, 1882..	2,500,000
The Coe Hill Mining Company	May 7, 1883..	750 000
The Cleveland Mining Company of Ontario	Dec. 8, 1884..	750,000

Name of Company.	Date of Charter.	Capital.
The Cross Lake Silver Mining Company, Limited	Mar. 29, 1892..	$ 50,000
The Commercial Mining Company of Algoma, Limited	April 22, 1892..	100,000
The Crescent Nickel Mining Company of Algoma, Limited	Oct. 7, 1892..	200,000
The Creighton Gold Mining Company, Limited	Nov. 16, 1892..	1,000,000
The Crystal Gold Mining Company of Rathbun, Limited	Nov. 1, 1894 .	1,000,000
The Canonto Mica and Mineral Company, Limited	Oct. 10, 1895..	22,000
The Credit Forks Mining and Manufacturing Company	Feb. 14, 1896..	200,000
The Canadian Gold Fields Company, Limited (an Imperial Company Licensed)	Dec. 24, 1896..	2,000,000
The Citizens Gold and Coal Mining Company of Sudbury, Limited	April 13, 1897..	1,000,000
The Coronado Gold Mining Company of Rat Portage, Limited.	Mar. 3, 1897..	40,000
The Central Ontario Mining Company, Limited	Mar. 1, 1897..	49,000
The Cronsted Mining Company of Algoma, Limited	Feb. 24, 1897..	450,000
The Comstock Gold Mining and Development Company of Ontario, Limited	Mar. 15, 1897.	600,000
The Czar Gold Mining Company of Ontario, Limited	Mar. 23, 1897..	1,000,000
The Climax Gold Mine Company of Ontario, Limited	Mar. 23, 1897..	1,000,000
The Consolidated Gold Fields Development Company of Ontario, Limited	May 5, 1897..	2,000,000
The Canada Mineral Water Company of Toronto, Limited	June 1, 1897..	2,000
The Combined Gold Mines Company of Ontario, Limited	June 21, 1897..	1,000,000
The Cameron Islands Mining and Development Company, Limited	Nov. 10, 1897..	250,000
The Chippewa Gold Mining Company of Ontario, Limited	Sept. 25, 1897..	1,000,000
The Desert Lake Iron Company	June 30, 1881..	250,000
The Denison Mining Company of Ontario, Limited	Sept. 8, 1888..	250,000
The Drury Nickel Company, Limited	Jan. 6, 1892..	500,000
The Delaware and Mount Brydges Oil and Gas Company, Limited	Mar. 23, 1897..	10,000
The Diamond Jubilee Mineral Development Company of Ontario, Limited	May 12, 1897.	2,000,000
The Detroit and Hastings Mining and Milling Company, Limited	Nov. 3, 1897..	2,000,000
The Diamond Park Mineral Water Company of Arnprior, Limited	Nov. 27, 1897..	20,000
The Enterprise Mining Company of Black Bay, Lake Superior.	May 27, 1877..	300,000
The Erie Mining Company of Ontario	Jan. 9, 1880..	30,000
The Elgin Silver Mining Company, Limited	May 9, 1882..	50,000
The Electro-Mercurial Amalgamator and Mining Company of Ontario, Limited	July 22, 1890..	100,000
The Eagle Nest Gold Mining Company of Ontario, Limited	Aug. 3, 1892..	200,000
The Empress Gold Mining Company of Ontario, Limited	Feb. 7, 1896..	100,000
The Equitable Mining and Development Company of Ontario, Limited	Mar. 10, 1897..	1,000,000
The Eastern Mining Syndicate of Ontario, Limited	Feb. 17, 1897..	1,000,000
The Economic Gold and Nickel Pyritic Smelting Company of Sudbury, Limited	April 14, 1897..	300,000
The Eastern Townships Mining and Development Company of Ontario, Limited	June 23, 1897..	500,000
The Eureka Mining Company of Thessalon, Limited	July 8, 1897..	199,000
The Elginfield Oil and Gas Developing Company of Dutton, Limited	May 5, 1897..	49,000
The Foxton Phosphate Mining Company and Imperial Company, Licensed	Sept. 7, 1890..	60,000
The Fairbanks Consolidated Mining Company, Limited	June 26, 1890..	500,000
The Foley Mines Company of Ontario, Limited	Nov. 25, 1896..	1,000,000

Name of Company.	Date of Charter.	Capital.
The Fort Frances Mining Company, Limited	May 26, 1897..	$ 40,000
The Folger Hammond Mines Company, Limited	Oct. 7, 1897..	1,000,000
The Furnace Falls Iron Co	Sept. 12, 1883..	100,000
The Galway Mining Company	July 18, 1868..	20,000
The Gladstone and Sulphuret Gold Mining Company of Ontario, Limited	Feb. 16, 1882..	300,000
The Gould Lake Mining Company, Limited	Nov. 27, 1889 .	300,000
The Gravel Bay Mining Company of Ontario, Limited	Jan. 25, 1890..	100,000
The Gold Rock Mining and Smelting Company of Algoma and Nipissing, Limited	Jan. 23, 1896..	100,000
The Great Northern Mining Exploration and Development Corporation of Ontario, Limited	Dec. 2, 1896..	475,000
The Golden Fissure Mining Company of Ontario, Limited	Dec. 24, 1896..	1,000,000
The Grimsby Gold Mining Company, Limited	Jan. 8, 1897..	200,000
The Golden Goblin Mining Company of Ontario, Limited	Jan. 20, 1897..	500,000
The Gold Hills Exploration and Development Company of Toronto, Limited	Jan. 27, 1897..	2,000,000
The Gagné Island Gold Mine Company of Ottawa, Limited	Feb. 12, 1897..	500,000
The Golden Gate Mining and Development Company of Rainy River, Limited	March 10, 1897..	300,000
The Gold Brick Mining and Development Company of Saw Bill Lake, Limited	April 7, 1897..	500,000
The Golden Island Mining Company of Rainy River, Limit d.	April 30, 1897..	750,000
The Gold Cliff Mining and Development Company, Limited	April 17, 1897..	1,000,000
The Golden Star Mining and Exploration Company of Ontario, Limited	May 26, 1897 .	1,000,000
The Gold Quartz Free Milling, Mining and Development Company of Ontario, Limited	June 11, 1897..	2,000,000
The Golden Prince Mining and Development Company of Algoma, Limited	May 5, 1897..	750,000
The Gold Horn Mining Company of Lennox and Addington, Limited	May 20, 1897..	45,000
The Golden Crown Mining Company of Ontario, Limited	June 23, 1897..	950,000
The Gold King Mining Company of Toronto, Limited	July 7, 1897..	2,000,000
The Great Granite Gold Mining and Development Company of Ontario, Limited	Aug. 12, 1897..	5,000,000
The Gold Creek Mines and Exploration Company of Ontario, Limited	Aug. 19, 1897..	500,000
The Garcia Gold Mining Company of London, Limited	Oct. 20, 1897..	50,000
The Gold Fields Company of Michipicoton, Limited	Nov. 27, 1897..	1,000,000
The Grand Calumet Mining Company of Ottawa, Limited	Dec. 1, 1897..	475,000
The Highland Mining Company	May 22, 1875..	600,000
The Hastings Iron Company, Limited	Dec. 1, 1880..	150,000
The Huronian Mining Company of Ontario	Feb. 20, 1883..	100,000
The Heron Bay Mining Company	July 19, 1883..	200,000
The Haliburton Mining Company, Limited	Sept. 17, 1890..	100,000
The Homestake Mining Company of Algoma, Limited	April 23, 1892..	300,000
The Hastings Mining and Reduction Company, Limited	Aug. 4, 1892..	100,000
The Hamilton Natural Gas and Mining Company, Limited	Oct. 27, 1892..	50,000
The Heather Bell Gold Mining Company of Toronto, Limited	Nov. 6, 1896..	1,000,000
The Hammond Gold Reef Mining Company, Limited	March 17, 1897..	1,000 000
The Hawk Bay Gold Mining Company, Limited	Jan. 29, 1897..	150,000
The Hub Gold Mining and Development Company of Ontario, Limited	April 17, 1897..	600,000
The Hamilton Iron Mining Company, Limited	May 12, 1897..	90,000
The Hastings Silver-Lead Mining Company, Limited	Aug. 12, 1897..	50,000
The Hiawatha Gold Mining and Milling Company of Ontario, Limited	Aug. 13, 1897..	500,000

Name of Company.	Date of Charter.	Capital.
The International Silver Mining Company of Ontario	June 24, 1875..	$2,000,000
The Imperial Land and Mining Syndicate of Algoma, Limited.	May 9, 1888..	200,000
The Inter-Ocean Mining and Prospecting Company of Toronto, Limited	Jan. 20, 1897..	1,000,000
The Industrial Mining, Development and Investment Company of Toronto, Limited	March 17, 1897..	150,000
The Indian Chief Gold Mining and Development Company of Ontario, Limited	April 14, 1897..	1,000,000
The Investors Mining and Development Company of Toronto, Limited	April 28, 1897..	1 000,000
The Intercolonial Deep Well Boring and Manufacturing Company of Petrolea, Limited	Aug. 12, 1897..	150,000
The Jackfish Lake Mining Company	May 22, 1875..	600,000
The Jackfish Bay Syndicate Mining Company, Limited	April 23, 1897..	99.000
The John Dwyer Gold Mining Company of Toronto, Limited..	July 23, 1897..	450,000
The Kashabowie Mining Company	April 12, 1876..	500,000
The Kingston and Pembroke Iron Mining Company.	May 11, 1887..	5,000,000
The Kaladar Mining Company, Limited	Sept. 1, 1890..	120,000
The Kingston Phosphate Company, Limited (An Imperial Company authorized to do business in Ontario)	March 12, 1890..	25,000
The Keewatin Gold Mining, Prospecting and Development Company, Limited	April 7, 1897..	750,000
The Kabaskong Gold Mining Company of Ontario, Limited...	April 21, 1897..	500,000
The Kobold Gold Mining Company of Ottawa, Limited	Nov. 12, 1897..	500.000
The Klunck Brick and Stone Slab Company of Toronto, Limited	Dec. 6, 1897..	75,000
The Klondike and North-West Mining Corporation of St. Thomas, Limited	Dec. 15, 1897..	475,000
The Lake Superior Silver and Gold Mill Reducing Works and Mining Company of Thunder Bay	June 4, 1875..	400,000
The Lavant Mining Company, Ontario	April 15, 1882..	500,000
The Lake Superior Native Copper Company, Limited (Licensed)	Sept. 9, 1882.....	.
The Lake Superior Copper Company, Limited, formerly Lake Superior Native Copper Company	June 24, 1885..	600,000
The Lake Superior Mining Company Limited (An Imperial Co'y authorized to do business in Ontario)	Feb. 10, 1890..	100,000
The Lake of the Woods Gold and Silver Reduction Company, Limited	April 16, 1890..	500,000
The Low Phosphorus Ore Properties Company of Ontario, Limited	Oct. 20, 1892..	350,000
The Ledyard Gold Mines Company, Limited	Mar. 7, 1894..	1,000,000
The Lake Opinicon Phosphate Company, Limited	Sept. 15, 1894 .	15,000
The Lake Harold Gold Mines Company, Limited	June 12, 1896..	150,000
The Lake Harold Gold Mines Company, Limited.	Dec. 9, 1896..	1,000,000
The Lakeside Gold Mining Company of Rat Portage, Limited.	Jan. 6, 1897..	750,000
The Leap Year Consolidated Gold Mining Company, Limited.	Jan. 27, 1897..	1,000,000
The La Reine Gold Mining Company of Ontario, Limited	April 12, 1897..	1,000,000
The Lake Medad Portland Cement Company, Limited	April 13, 1897..	150,000
The London Oil Company, Limited	Sept. 2, 1897..	3,000
The Mississippi Mining Company	Aug. 4, 1880..	200,000
The Michipicoten Native Copper Company, Limited (A licensed Imperial Co)	Sept. 14, 1882..	500.000
The Michipicoten Copper Company (previously Michipicoten Native Copper Co)	Nov. 30, 1883.....	
The Marmora Gold and Iron Mining Company	Nov. 29, 1882..	500,000
The Maple Leaf Gold Mining Company of Ontario, Limited...	May 1, 1889..	20 000

Name of Company.	Date of Charter.	Capital.
The Mattawan Iron Mining Company, Limited	July 21, 1891..	$ 100,000
The Marmora Reduction Company	May 30, 1894..	24,000
The Mikado Gold Mining Company, Limited (An Imperial Company, Licensed)	Nov. 6, 1896..	225,000
The Mississaga River Gold Mining Company of Ontario, Limited	Jan. 13, 1897..	490,000
The Magatherium Gold Mining Company of Jackfish, Limited	April 7, 1897..	100,000
The Minerals Exploration and Development Company of Ontario	April 2, 1897..	2,000,000
The Mandarin Gold Mining Company of Ontario, Limited	April 14, 1897..	300,000
The Mica and Mining Company of Ontario, Limited	April 28, 1897..	75,000
The Mines Selection Company of Toronto, Limited	May 26, 1897..	200,000
The Mineral King Mining and Development Company of Ontario, Limited	May 26, 1897..	77,000
The Mohawk Mining Company of Rat Portage, Limited	April 21, 1897..	495,000
The Manitou Gold Mining Company, Limited	May 12, 1897..	1,000,000
The Mines Investment Association of Ontario, Limited	June 1, 1897..	100,000
The Methuen Mining Company, Limited	June 1, 1897..	450,000
The Mine Centre Development Company, Limited	Aug. 27, 1897..	50,000
The McNab Iron Company	May 15, 1897..	50,000
The McGown Gold Mining Company of Parry Sound, Limited	April 7, 1897..	1,000,000
The McIntosh Granite and Marble Company, Limited	April 21, 1897..	48,000
The Native 7 Silver Mining Company (previously Canada First Silver Mining Company	Oct. 27, 1875..	500,000
The Neebish Mining Company	May 22, 1875..	600,000
The North Lake Mineral Land Company of Ontario, Limited	Dec. 19, 1888..	168,000
The North American Chemical Mining and Manufacturing Company of Ontario (changed to Owen Sound Portland Cement Co., Limited	April 16, 1888..	100,000
The North Shore Nickel and Copper Mining Company, Limited	April 7, 1891..	500,000
The Nickel Belt Mining Company of Graham, Limited	Dec. 16, 1891..	75,000
The Neepawa Gold Mining Company of Ontario, Limited	Feb. 3, 1897..	1,000,000
The Nugget Gold Mining Company of Rat Portage, Limited	Feb. 12, 1897..	50,000
The Nan Ki Poo Gold Mining Company of Ottawa, Limited	Feb. 17, 1897..	1,000,000
The New Ontario Mining and Development Company, Limited	May 12, 1897..	50,000
The North Star Mining and Development Company of Toronto, Limited	April 21, 1897..	5,000,000
The Ontario Mining and Manufacturing Company, Limited	Dec. 28, 1875..	50,000
The Ontario Joint Stock Phosphate Mining Company, Limited	April 18, 1883..	20,000
The Opinicon Mining Company	July 3, 1888..	50,000
The Ogema Mining and Smelting Company of Thunder Bay, Limited	Feb. 5, 1891..	150,000
The Ontario Nickel Mountain Mining Company, Limited	May 7, 1891..	500,000
The Ontario Silver and Antimony Mining Company	Dec. 29, 1892..	300,000
The Ontario Mines Development Company, Limited	Oct. 30, 1896..	50,000
The Ontario Gold Fields Mining and Development Company, Limited	Jan. 6, 1897..	2,500.000
The Original Swede Boys' Prospecting Company of Rainy River, Limited	Mar. 10, 1897..	90,000
The Ottawa Gold Milling and Mining Company, Limited	April 9, 1897..	1,000,000
The Ontario Reefs Mining and Development Company, Limited	April 17, 1897..	5,000,000
The Ontario Prospectors' Mining and Development Company, Limited	April 21, 1897..	1,000,000
The Oriole Gold Company of Wabigoon and Saw Bill Lakes, Limited	July 21, 1897..	24,000

Name of Company.	Date of Charter.	Capital.
The Ontario Lithographic Stone and Mining Company, Limited	Nov. 10, 1897..	$ 250,000
The Otisse Gold Mining Company of Schreiber, Limited	Dec. 6, 1897..	1,000,000
The Percy Mining Company	Mar. 13, 1888..	30,000
The Providence Gold Mining Company of Norland, Limited	May 2, 1895..	40,000
The Princess Gold Mining Company of Ontario, Limited	Oct. 21, 1896..	500,000
The Preston Gold Mining Company of Seine River, Limited	Nov. 4, 1896..	50,000
The Pipestone Gold Mining Company, Limited (an Imperial Co., Licensed)	Aug. 6, 1896..	500,000
The Premier Gold Mining Company of Ontario, Limited	Mar. 10, 1897..	495,000
The Plutus Gold Mining Company of Sault Ste. Marie, Limited	Feb. 5, 1897..	1,000,000
The Palmita Mining and Development Company of London, Limited	June 23, 1897..	1,000,000
The Peninsular Mining and Development Company of Ontario, Limited	June 23, 1897..	900,000
The Producers' Oil, Gas and Mining Company of Welland, Limited	Dec 18, 1897..	10,000
The Queen Bee Gold Mining Company of Ottawa, Limited	Feb. 15, 1897..	1,000,000
The Queen of the Lakes Gold Mining and Development Company of Ontario, Limited	Mar. 23, 1897..	1,000,000
The Queenston Quarry Company, Limited	April 17, 1897..	50,000
The Roberts Iron Company, Limited, Ontario	Dec. 3, 1880..	100,000
The Rabbit Mountain Mining Company of Ontario, Limited	Nov. 5, 1897..	2,000,000
The Rainy River Mining Company, Limited	Nov. 4, 1896..	1,000,000
The Rupert Mining Company of Ontario, Limited	Feb. 5, 1897..	200,000
The Rand Gold Mining Company of Wabigoon, Limited	May 5, 1897..	1,000,000
The Railroaders' Gold Mining Company of Ontario, Limited	Sept. 2, 1897..	500,000
The Superior Silver Mining and Land Company	Feb. 2, 1871..	40,000
The Shaftesbury Gold Mining Company of Lake Shebandowan	Oct. 21, 1873..	50,000
The Shebandowan Mining Company	Mar. 25, 1875..	1,000,000
The Silver Lake Mining Company	Dec. 31, 1875 .	1,200,000
The Snowdon Iron Mining and Blast Furnace Company	Mar. 22, 1879..	100,000
The San Augustin Mining Company of Toronto, Limited	May 7, 1884..	1,250,000
The Storrington Mining Company	Sept. 16, 1886..	30,000
The Sudbury Mining Company, Limited	Dec. 28, 1888..	100,000
The Sydenham Mica and Mining Company, Limited	May 10, 1889..	250,000
The Stirling Phosphate and Mining Company of Kingston	Jan. 4, 1890..	50,000
The Sault Ste. Marie North Shore Mining Company, Limited	Feb. 13, 1890..	300,000
The Silver Centre Mining Company of Ontario, Limited	June 20, 1890 .	300,000
The Standard Asbestos Company of Ontario	Nov. 12, 1890 .	100,000
The Sudbury Nickel Company, Limited	May 29, 1891..	50,000
The Sault Ste. Marie Nickel Mining and Agency Company	Oct. 15, 1891..	45,000
The Straight Lake Nickel Mining Company, Limited	Nov. 11, 1891..	300,000
The Sudbury Customs Smelting Company, Limited	March 15, 1892..	75,000
The Spanish River Talc and Nickel Mining Company of Algoma, Limited	Dec. 20, 1894..	96,000
The Saw Bill Lake Gold Mining Company, Limited	May 26, 1896..	100,000
The Seine Manitou Gold Mining Company, Limited	Sept. 9, 1896..	100,000
The Standard Mining and Development Company of Ontario, Limited	Dec. 24, 1896..	500,000
The Sweden Gold Mine Company of Ontario, Limited	Jan. 6, 1897..	500,000
The Security Gold Mining and Development Company of Ontario, Limited	March 1, 1897..	1,500,000
The Sovereign Gold Mining and Development Corporation of Ontario, Limited	March 3, 1897..	2,500,000

Name of Company.	Date of Charter.	Capital.
The Shoal Lake and Seine River Mining Company, Limited ..	April 7, 1897..	$ 600,000
The Scramble Gold Mining Company of Ontario, Limited	April 7, 1897..	1,000,000
The Sylvan Oil Company of Ontario, Limited	June 8, 1897..	350,000
The Soo Mining and Exploring Company of Algoma, Limited.	June 23, 1897..	99,000
The Thunder Bay Silver Mining Company.....	June 2, 1868..	400,000
The Toronto and Whitby Mining Company	June 13, 1868..	50,000
The Toronto Gold Mining Company.....	Oct. 30, 1873..	500,000
The Toronto Mining and Exploring Company, Limited	July 26, 1882..	2,880
The Thunder Bay Land and Mining Company	Dec. 11, 1883..	40,000
The Thornbury Oil and Mining Company	Nov. 12, 1886..	30,000
The Toronto Mining Association, Limited.....	Jan. 21, 1891..	3,000
The Taché Gold Mining Company of Ontario, Limited	Nov. 3, 1892..	500,000
The Toronto Nickel Company, Limited	Dec. 14, 1892..	300,000
The Trill Mining and Manufacturing Company, Limited.....	July 7, 1896..	1,000,000
The Temiscamingue Lithographic Stone and Mining Company, Limited	Mar. 20, 1896..	100,000
The Toronto-Tudor Mining Company, Limited.	Jan. 20, 1897..	1,000,000
The Thessalon Gold Mining Company, Limited.....	March 3, 1897..	800,000
The Toronto and Western Mines Development Company, Limited	Jan. 13, 1897..	50,000
The Union Mining Company	April 9, 1868..	60,000
The Union Jack Gold Mines Company of Foley, Ontario, Limited	Aug. 27, 1897..	150,000
The Victoria Gold Mining Company of Toronto	Feb. 17, 1868..	3,500
The Victoria Mining Company, Limited.....	Oct. 6, 1883..	500,000
The Vermilion Mining Company of Ontario	Feb. 21, 1888..	240,000
The Victoria Mining Company of Ontario, Limited.....	Dec. 2, 1896..	450,000
The Wilbur Mining and Manufacturing Company	Aug. 28, 1882..	200,000
The Wahnapitae Mining Company.....	Oct. 31, 1888..	30,000
The West End Mining Company of Ontario, Limited	June 28, 1889..	2,000,000
The Western Ontario Mining Company, Limited	Nov. 18, 1896..	1,000,000
The Wabigoon Free Milling Gold Mining Company, Limited ..	Feb. 17, 1897..	1,000,000
The Webwood General Mining and Development Company, Limited	March 23, 1897 .	490,000
The Willow Creek Gold Mining and Development Company of Brantford, Ontario, Limited.....	May 6, 1897..	99,000
The Walpole Ore Company, Limited	Oct. 15, 1897..	20,000
The Y. One Mining Company.....	Sept. 27, 1875..	1,000,000
The Yum Yum Gold Mining Company of Ottawa, Limited....	Dec. 24, 1896..	1,000,000
The Yankee Doodle Mining Company of Toronto, Limited	Sep. 22, 1897..	45.000
The Yellow Jacket Gold Mining Company of Seine River, Limited	Aug. 19, 1897..	90,000
The Yukon Mutual Mining and Exploring Company of Toronto, Limited.....	Oct. 6, 1897..	20,000
The Yukon Nugget Gold Mining and Exploration Company of Paris, Limited	Dec. 15, 1897..	250,000

Comparison of 1896 and 1897.

For the year 1896 the total number of mining companies organized in the Province was 26, and the total amount of their authorized capital was $15,600,000. In 1897 the number was 136, and the aggregate of their authorized capital was $98,356,000. Charters issued prior to April 13 were granted under the provisions of The Ontario Joint Stock Companies' Act, while those issued from that date were granted subject to the provisions of The Ontario Mining Companies' Incorporation Act, with powers to carry on in all their branches the operations of a mining, milling,

reduction and development company. In addition to the 136 companies incorporated under the Ontario statutes, four companies formed under the Imperial Joint Stock Companies Acts have secured licenses under the provisions of the Act for the Regulation of Mining Companies, viz.; The Canada Venture Syndicate, Limited with £20,000, The Canadian Pacific Exploration, Limited, with £500,000, The Northwestern Ontario Exploration Company, Limited, with £15,000, and The Ontario, Limited, with £100,000. This makes a total of 140 companies, with an aggregate authorized capital of $101,531,000, nearly all of which have been incorporated with the object of engaging in the mining business in Ontario. It is not likely that all of them will engage in actual work; the records of the last thirty years in Ontario show that many companies obtained charters and never exercised their powers in a practical way. But with the opportunities that are presented for mining enterprise in the northern and eastern districts of the Province, and with the spirit of venture that has seized hold of our people, the influence of so many new corporations must be noticeable in the progress of mining development during the present and succeeding years.

Mining Lands

The activity which began to be shown in applying for and taking up mining locations during the last three months of 1896 was maintained throughout the whole of last year. Since its organization in 1891 the Bureau of Mines had administered the mineral lands in the surveyed portions of the Province, but owing to the extension of its work in other directions it became necessary last year to transfer the applications for these lands to the Sales Branch. The Surveys Branch was also strengthened by the employment of a number of extra clerks and draughtsmen; and although some relief was afforded by the opening of an office at Rat Portage, where applications from the Lake of the Woods were received and dealt with, it was with extreme difficulty that the requirements of the public could be met." The following table shows the number of locations sold during the year by districts, with their area and the amounts paid into Treasury as purchase money:

Increase of transactions in 1897.

Distri t.	No. of Sales.	Acres.	
Rainy River.....	442	26,739	5
Thunder Bay.....	9	917	
Algoma	5	448½	
Elsewhere	16	1,690	
Totals	472	29,794½	5

The next table gives the statistics i same way for mining locations leased d the year.

District.	No. of Lessees.	Acres.	
Rainy River.....	703	74,154	7
Thunder Bay.....	38	7,063	
Elsewhere	42	4,797½	
Totals	783	86,014½	8

The total number of locations sol leased in the year was 1,255, with an a 115,809 acres, for which the a paid into the Treasury was 299.06. But there was a f sum of $6,241.11 paid as rental on leased in previous years, and this mak aggregate of $150,540.17. These figur not include the receipts from the is mining licenses and other fees in conn with the staking out and recording of n claims in the Michipicoton Division amount of which was $3,021.

Total revenue from Sales and Rentals.

This volume of business will be best a ciated when it is compared wi total transactions for the five ceding years, as shown i following table:

A comparative statement.

——	1892-96.	18
Number of sales	407	4
Acres	32,294½	29,
Price paid.....$	72,360 00	59,4
Number of leases	619	7
Acres	61,527½	86,
Rent paid ..... $	59,158 68	84,8
Rent of lands previously leased .....$	15,440 30	6,2

The number of locations sold and leased t y ear was greater than in the five previous ars by 229, the area was greater by 21,987¼ res, and the amount received exclusive of e rent of lands previously leased was greater r $12,780.38. Inclusive of the rent of lands eviously leased, the revenue from mining nds last year was greater than for the five evious years by $3,581.19.

The transactions of each of the six years 92-7 are given in the next table:

Year.	Locations sold.			Locations leased.			Rental of lands previously leased.
	No.	Acres.	$	No.	Acres.	$	
1892	65	6,200	15,273	95	13,122½	12,314 36	603 00
1893	63	4,370	11,489	122	13,046½	11,933 90	2,735 86
1894	40	3,271	7,646	66	7,050½	6,488 78	3,807 78
1895	99	7,720	15,868	175	15,084	14,924 00	3,287 16
1896	140	10,733½	22,084	161	13,223½	13,497 64	5,006 50
1897	472	29,794	59,478	783	86,014	84,821 35	6,241 11
Totals	879	62,088½	131,838	1402	147,541¼	143,980 03	21,681 41

The total number of locations sold and leased in the six years 1892-7 was 2,281, the total area was 209,629¾ acres and the total amount received for sales and rents was $297,498.44.

Popularity of the leasing system.

The popularity of the leasing system is shown by the number and area of locations taken up under it, the locations leased exceeding those sold in the six years by 523 in number and by 85,452¾ acres in extent. The revenue from rents was greater than the revenue from sales in the six years by $33,823.44.

Mineral Production

Heretofore much delay has been caused in the preparation of the Bureau's Reports by the slowness with which returns of statistics have been made. Especially has this been the case with the statistics of stone quarries, lime kilns, brick yards and pottery works. This year no attempt has been made to collect the figures for these industries, and in the summary table which follows they do not of

Product	Quantity.	Value.	Employes	Wages.
		$		$
Cement, natural rock ..... barrels.	84,670	76,123	70	21,500
Cement, Portland ..... "	96,825	170,302	161	67,560
Pressed brick, plain ..... number.	7,148,908	53,727	143	40,084
Pressed brick, fancy ..... "	895,000	9,350		
Roofing Tile	35,000	400		
Terra Cotta	.....	35,800		
Paving Brick	4,567,880	45,670	66	23,226
Sewer Pipe	.....	73,551	64	19,600
Petroleum ..... imperial gallons.	25,556,591	.....	.....	.....
Illuminating Oil .. "	10,891,337	1,131,083	364	196,356
Lubricating Oil .... "	1,959,810	199,755		
Benzine and Naphtha, "	949,341	77,340		
Gas and Fuel Oils and Tar	8,021,633	281,035		
Paraffin Wax and Candles ..... lb.	2,139,278	88,378		
Natural Gas	.....	308,448	84	42,338
Calcium carbide ..... tons.[1]	574	34,440	30	12,544
Salt ..... "	54,686	249,880	210	58,530
Gypsum and products of ..... "	1,729	17,950	.....	.....
Graphite and products of ..... "	400	8,500	15	5,000
Iron ..... "	24,011	288,127	130	40,000
Nickel ..... "	1,999	359,651	535	253,226
Copper ..... "	2,750	200,067		
Gold ..... oz	11,412	190,244	430	212,966
Totals 1897	.....	3,899,321	2,302	993,530
Totals 1896	.....	3,794,003	1,822	818,726

[1] Net tons of 2,000 lb.

course appear. The total amounts are accordingly much less than in former years; but as shown by the detailed statistics hereafter given, and as appears by the comparative figures of totals for 1896 and 1897, some progress is being made.

Cement.

Gratifying progress of the Industry.

The cement industry is steadily winning its way forward in Ontario. Both the natural rock and Portland cements are showing a large increase of production, and manufacturers are establishing a good reputation for the qualities of the cements they are putting on the market. The increase however is not shown in the number of establishments, which are two less now than they were four years ago; but in number of men employed and amount of wages paid for labor, in quantity of cements produced and in their value there is gratifying evidence of progress. The following table gives the statistics of the industry for the four years 1894-97:

Schedule.	1894.	1895.	1896.	1897.
Natural rock cement—				
Number of works	5	5	5	4
Number of workmen	63	45	56	70
Wages for labor...$	13,020	14,166	15,200	21,500
Product...bbl.	55,323	55,219	60,705	84,670
Value of product...$	48,774	45,145	44,100	76,123
Portland cement—				
Number of works	3	2	2	2
Number of workmen	105	129	120	161
Wages for labor...$	31,858	46,000	48,400	67,560
Product...bbl.	30,580	58,699	77,760	96,825
Value of product...$	61,060	114,332	138,230	170,302

The number of men employed in these four years has increased from 168 to 231, the wages paid for labor from $44,878 to $89,060, the quantity of cement manufactured from 85,903 barrels to 181,495 barrels, and the value of the cement from $109,834 to $246,425. The greatest increase however has taken place in the production of Portland cement, which has gone up from 30,580 barrels to 96,825, while the natural rock cement has only increased from 55,323 barrels to 84,670. In value natural rock cement shows an increase of $27,349, while Portland cement shows an increase of $109,242. This no doubt is largely if not chi owing to the growing interest in the bu ing of good roads in our towns and cities.

Natural rock Cement Works.

All of the natural rock or hydraulic cem works are now situated along the Nia escarpment, extending from Qu ston near the Niagara river Limehouse on the main lin the Grand Trunk Railway.

Owen Sound Company's Works.

One of the Portland cement work situated at Shallow lake in Grey cou where the business is carried by the Owen Sound Portl Cement Company. New mac ery was added during the past year, and buildings and more kilns are now in co of erection which when completed earl the summer will bring the output up to 300 barrels per day. The product of works is known as the Samson brand, the manager states that not a single c plaint was received last year regarding quality of the material put upon the mar

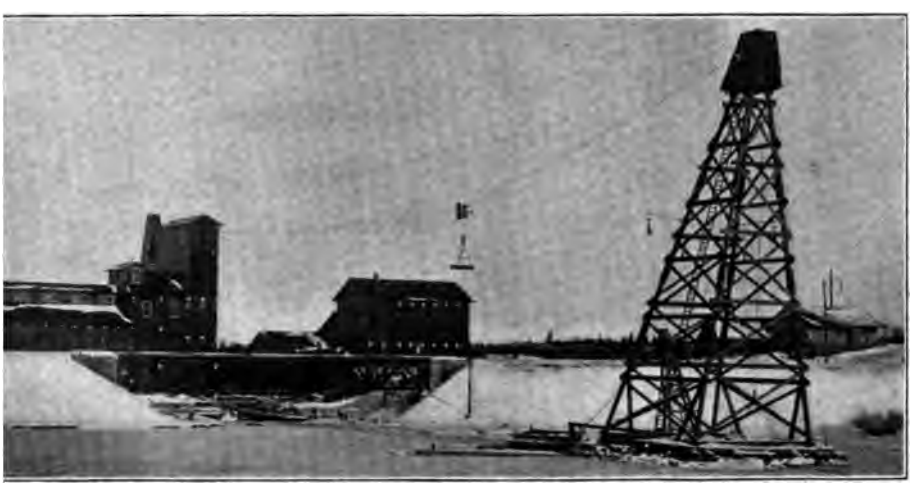
Both the marl and the clay used in manufacture of cement at these works obtained from the bed of Shallow lake.

Rathbun Company's Works.

The works of the Rathbun Compan Napanee Mills were also enlarged last y and they have now an estim capacity of about 350 barrels day. The plant embraces latest and best developments in Port cement making, and is constructed wi view to produce material of very unif quality. The clay and marl are mixe proportions carefully regulated by chem analysis, and the slurry is so finely redu

View of the Sultana Mine and Camp, p. 48.

Mine, p. 52, looking N.W., showing mill and main shaft house. Bag bay in the back ground with camps near the e. Open cut on No. 1 vein is seen to the left of the mill. Hoisting engine house to the left of open cut. To the right ıe mill in the foreground is the blacksmith shop, and behind it is the tramway running from the mill to No. 2 shaft.



n Reduction Works. Showing tramway for carrying ore from barges to works; river in the foreground and Railway track between it and works; office to the right, p. 60.

Crib of the Burley Mine. Built on the Company's island, about half a mile from Sultana island, p 49.

Tunnel on Gem vein, AD2 Mine, p. 74.

nixing mills that it will all pass a seive of 100-mesh, or 10,000 holes ,re inch. Two new burning kilns cted last year, making three in all ; of the continuous type and produce niform well burnt clinker. In the mill the clinkers are ground to an ly fine powder, and so finished it is l to bins in a new storehouse which pacity of 50,000 barrels. The Rath- ıpany's cement is known as the Star ut they are now producing a quality e Silica Portland. The marl for the drawn from an extensive deposit on of the Bay of Quinte Railway, and from a property adjoining the works. g the fiscal year ending June 30, nada imported 210,871 barrels of Port- ıent, valued in the Trade Returns at ' ; so there is yet considerable room nsion in the industry at home.

c, Terra Cotta and Sewer Pipe.

lackness in the building trade still s to depress the pressed brick industry, as shown by the following statistics for the seven years 1891-97 :

	Number.	Value.	Wages.
		$	$
....	13,617,909	156,699	58,000
....	22,048,000	259,335	88,865
....	21,634.000	217,373	80,686
....	25,456,000	286,230	95,400
....	17,940,867	184,550	69,442
....	12,201,000	129,845	60.824
....	8,043,908	99,277	40,084

mbers in this table include only nd fancy pressed brick, while the nd wages paid for labor include in roofing tile and terra cotta—the last mbracing the architectural and porous s. The industry employed last year ıge of 143 men, whose wage earnings 0,084.

nanufacture of paving brick is now g an established industry, and it is claimed that the quality of brick now produced is equal to the best American made brick heretofore im-

The quantity turned out at the works last year was 4,567,880, valued at $45,670, in the production of which 66 workmen were employed whose wage earnings were $23,226. In Toronto paving brick is growing steadily in favor as material for the construction of streets and sidewalks, and the demand for it here and elsewhere is likely to continue.

Sewer Pipe.

In the manufacture of sewer pipe last year 64 workmen were employed, whose total earnings were $19,600, and the value of pipe turned out at the works is given as $73,551.

Altogether these three clay industries gave employment last year to 273 workmen, whose aggregate wages were $82,310, and the amount of the products of their industry was $218,498.

Petroleum.

Production of Crude.

Crude petroleum to the amount of 25,556,591 imperial gallons and valued at $1,067,128 was distilled in the Province last year, being in amount 397,352 gallons more but in value $55,980 less than in the previous year. Six distilleries were employed in treating the crude, viz., those of the Imperial Oil Company, the Bushnell Company, the Petrolia Crude Oil and Tanking Company, and the National Oil Works at Petrolia, the works of the Empress Oil Company at London and the works of the Bushnell Company at Sarnia. The latter however was operated only during the months of October, November and December.

Distilled products.

The following table gives the distilled products of the six refineries for the year, and the value of each product:

	Imp. gal.	$
Illuminating oil	10,891,337	1,131,083
Lubricating oil	1,959,810	199,755
Benzine and naptha.....	949,341	77,340
Gas and fuel oils and tar..	8,021,633	281,035
Paraffin wax and candles. lb.	2,139,278	88,378

The total value of refined products is $1,777,591, which is $710,463 more than the value of the crude petroleum. In 1896 the value of distilled products was $1,955,295, which was $832,187 more than the value of the crude. The percentage of appreciation by treatment in 1896 was 74 per cent. and in 1897 it was 67 per cent. The cause is thus

stated by the president of one of the companies: "The tariff changes reduced crude values, and reductions in articles entering into cost manufacture carried a relatively greater reduction in refined, and products generally." The main item of decrease is observed to be in illuminating oils, which in quantity were 451,543 gallons and in value $132,147 less in the latter year than in the former. There is little change to note in the cost of labor, the average earnings in 1897 being $540.83 and in 1896 $541.33. The average number of workmen employed last year was 364, being 13 more than in the previous year, and the total amount of wage earnings was $196,955.70.

Percentages of products from Crude.

The next table is interesting in so far as it indicates the improvements which are being made in the process of distillation—the proportion of refined products recovered from the crude.

Product.	1892. p. c. of crude.	1893. p. c. of crude.	1894. p. c. of crude.	1895. p. c. of crude.	1896. p. c. of crude.	1897. p. c. of crude.
Illuminating oil	38.67	39.12	41.10	43.31	45.08	42.62
Lubricating oil	12.35	12.45	10 91	9.51	9.07	7 67
All other oils.....	27.34	28.14	30.45	28.07	31 09	35.10
Totals.....	78.36	79.71	82.46	80.89	85.24	85.39

Since 1892 the percentage of all oils obtained by distillation has increased from 78.36 per cent. to 85.39 per cent., and saving one year the improvement has been continuous. Last year however the proportion of illuminating oils is less than in each of the two preceding years, and the proportion of lubricating oil is less than in any one of the five preceding years. In this latter there has been a steady decrease in percentages. But in all other oils there is a noticeable increase, the percentage having gone up from 27.34 in 1892 to 35.10 in 1897. There is a marked increase too in the wax product, which was last year 607,607 lb. more than in 1896.

The Bothwell Territory.

The Bothwell field has not realised the expectations entertained of it at the close of 1896, and a number of the wells have already been abandoned by operators. The total product of crude as given in the returns was 1,048 imperial gallons, valued at $43,099. number of workmen employed, most of w were engaged in drilling new wells, wa and the amount of wages paid for labor $20,176. The Walker Oil and Gas Com drilled 32 wells during the year, all of w are reported as producing wells.

Exploiting a new Field in Dawn township.

A new oil field was exploited during year in the township of Dawn, near the lage of Florence. A numbe wells were drilled in the latter of the year, several of which good flows of oil. The pioneer in this t tory is Mr John Doran of Toronto, a st boat engineer, who claims that he locat with the help of an instrument or "rigg during the trips of the steamer Cambri and down the St. Clair river in the seas 1896. His first visit to the locality was i in January, 1897. "I had never been in country, before," he writes from Flo under date of December 23, 1897. "ha only passed through south and north of the trains, and hence knew absolutely not of it in any way. I got off the train at F well, walked out northwest two mile s, found that the attraction was quite a dist northwest yet. So I walked back and the stage to Florence, an inland town of people nine miles northwest of Both Upon arriving there I followed the attra northwest about 2½ miles, and after time spent with farmers trying to lease I ceeded in leasing a tract for one year." all about 2,800 acres was secured, an August Mr. Doran returned to begin o tions, having associated with him two of Port Huron who possessed some cap The first well was completed October having been drilled to a depth of 342 fee

which point salt water was struck, and it has pumped an average of two barrels per day. It is on the southwest quarter of lot 19 in the thirteenth concession of Dawn. The second well, 300 feet southeast of the first, was bored to 317 feet, and yielded at first at the rate of 30 barrels per day. The flow fell off gradually to one barrel, when the bore-hole was deepened to 356 feet and it was shot at 290 feet. The pump was again put in and the yield was found to be 10 barrels per day, at which rate it continued. Eleven wells were bored by Mr. Doran and his partners before the close of the year, all of which were producers. "I cannot describe to you my instrument for locating oil," Mr. Doran writes, "but would be pleased to show it to you and the workings thereof here or in Toronto." The wells have since been sold to Dr. Fairbank of Petrolia for $11,000, and there are now a number of other oil operators on the ground.

Natural Gas.

Condition of the Natural Gas supply.

There is nothing new to note in connection with natural gas, except that the value of the output is larger than in any previous year. This is due no doubt to the greatly increased number of consumers following upon the laying of pipes under Detroit river to supply the citizens of Detroit. The territory, both in the Essex and Welland fields, continues to be about the same as in previous years, and although a number of wells were bored in both fields last year the number of producing wells continues to be very nearly the same—some of the old wells apparently having become exhausted. The following table gives the statistics of natural gas for the five years 1893-97:

The Welland and Essex fields compared.

The Welland field, which embraces parts of Haldimand, has in all 106 producing wells and 140½ miles of pipe line. Last year 10 new wells were drilled, only six of which were producers. The value of its yield of gas was $96,078, and the business gave employment to an average of 38 men throughout the year whose total wage earnings were $22,630. In the Essex field 46 men found regular employment, and the amount paid them for wages was $19,708. The length of pipe line in that county is 156½ miles, the number of producing wells 34, and the value of gas supplied to consumers was $212,370. Nine wells were bored during the year, three of which proved to be dry holes. It should be stated however that eight of the so-classed producing wells are sealed up, awaiting a market, and therefore the whole supply was drawn from 26 wells. The town of Leamington, which owns its own wells, derived from them last year a revenue of $12,000. It has now 11 miles of pipe line laid within the corporation to serve consumers.

Calcium Carbide.

In several previous reports the Bureau has devoted considerable space to the subject of calcium carbide and acetylene gas. The account given in the Report of 1894 of Willson's method of producing the carbide, patented in that year, led to a large degree of public interest in the new illuminant, which also held out so bewildering a range of possibilities as a foundation for many useful compounds.

In the report for last year some of the difficulties were enumerated which hindered the general adoption of acetylene gas for lighting purposes, but since that time much

Schedule.	1893.	1894.	1895.	1896.	1897.
No. of producing wells	107	110	123	141	140
Miles of gas pipe	117	183½	248	287½	297
Workmen employed	59	99	92	87	84
Value of gas product	$ 238,200	204,179	282,986	276,710	308,448
Wages for labor	24,592	53,130	73,328	47,527	42,338

progress has been made. Continued study of the properties of the gas and experiment with it have evolved apparatus of various types for its generation and control, and the result has been that acetylene is now being rapidly introduced as a means of indoor lighting throughout the Province of Ontario. The field which seems specially open for it is that afforded by the smaller towns and villages, where gas plants are not already in existence and where the electric light is used, if at all, only in the form of the arc lamp for illuminating public streets. Here a system of lighting is welcomed which does not necessitate an expensive central plant or a costly equipment of mains, and which does not require a large number of consumers to ensure a reasonably low cost. The advantage possessed by acetylene in this regard is, that it provides an isolated method of lighting, which can be adopted by one person in a town or village, or even by a farmer on his homestead, without reference to any one else and without increase of cost. This feature of acetylene lighting has doubtless in large measure been the cause of the favorable reception it has had in Ontario during 1897.

Adoption of Acetylene Gas for Lighting purposes.

There are now eight firms engaged in manufacturing acetylene generators in the Province, as follows: J. Wallace & Sons, Hamilton, The Niagara Falls Acetylene Gas Machine Company, Niagara Falls, Leishman & Maundrell, Woodstock, The Hamilton Acetylene Gas Machine Company, Hamilton, The Guelph Acetylene Gas Machine Company, Guelph, The Acetylene Lighting Company, St. Mary's, The Acetylene Lighting Company of London, Limited, London, and the Welland Acetylene Gas Machine Company of Welland. One of these firms reports having placed 94 of its machines since January, 1897, mostly in Ontario, but several also in the United States and Mexico. The plants range in size from 15 to 100 lights. They are used for the lighting of stores, churches, manufactories, rinks, and dwelling houses. Another firm mentions a few of their principal patrons, 35 in number; a third firm enumerates 55 places in which they have set up 186 machines, ranging in size from five to 150 lights, but having a total of 4,535 lights. The majority of these generators were put up in Ontario, mainly in the smaller towns, but a number of them went to other Provinces of the Dominion, among them 41 to Winnipeg, while 10 are said to have found their way to Klondike. A fourth firm could give "an endless list" of their customers, if desired, but furnish 15 only, among whom are five churches and one Government institution; a fifth sends the names of 18 users of their machines. From the fact that acetylene has so far been introduced mainly outside of cities and towns having gas plants already in operation, it is probable that it has taken the place of coal oil in the majority of cases, and to a smaller extent that of the electric light.

Manufacturers of Acetylene Generators.

As to the cost of installing the light, this varies with the style and capacity of generator employed. One of the firms named above quotes its prices for the several sizes as follows: 15-light $40, 25-light $45, 35-light $50, 45-light $55, 60-light $70, 65-light $85, 100-light $115, 150-light $145. On the other hand the Springfield Acetylene machine, made in Springfield, Mass., is advertised to sell at prices ranging from $125 for a 10-light machine to $450 for a 100-light one. This Springfield generator is situated wholly underground, which it is claimed reduces the danger and offensive smell to a minimum. Plants of other make are usually situated in the basement or cellar of the building which they are intended to serve.

Cost of installing Light Plants.

As to the cost of operating the light plant, this is dependent almost wholly upon the cost of the carbide of calcium, as the only other ingredient used in producing the gas is water. The carbide used in Ontario is manufactured wholly by the Willson Carbide Works Company of St Catharines, and costs three cents per pound, or, allowing for freight, about 3½ cents. Messrs. J. Wallace & Son of Hamilton state that by actual experiment and photometric test with carbide at $60 per ton, the cost of the acetylene gas has been found to be 12 cents per 1,000 candle power hours. The Niagara Falls Acetylene Gas Machine Company state that in practice with carbide at 3½ cents per pound they find they can

Cost of operating a Plant.

produce a full 36-candle power light at a cost of three-eighths of a cent per hour. The Acetylene Lighting Company of London write that in their experience acetylene gas costs about $6 per 1,000 cubic feet, or one cent per hour for 85 candle power; while the Hamilton Acetylene Gas Machine Company quote the words of their agent at Wyoming: "We started a B. & J. machine on 30lb. of carbide and kept a close watch on it, finding as a result that it gave 160 hours' light of 50 candle power. This reduced to cost means 320 hours' light of 25 candle power, at a cost of 90 cents, or $\frac{7}{8}$ of a cent per hour for 25 candle power light." These several estimates vary a little, but not much.

Acetylene Gas and Coal Gas compared as to Cost.

By the law of Canada (Consolidated Statutes, 1886, chap. 101) the quality of illuminating gas must be such that the light produced by a standard burner consuming five cubic feet of gas per hour shall be equal in intensity to that produced by 16 sperm candles of six to the pound, two candles being used together. Taking the estimate of the Hamilton Acetylene Gas Machine Company, as given above, to be approximately correct as to the quantity of light produced, and assuming the cost of carbide to be 3½ cents per pound, a comparison with illuminating gas equal to that furnished the citizens of Toronto, which is stated to be of 20.18 candle power, would work out as follows: One thousand cubic feet of coal gas burning for one hour would give 4,036 candle power and cost 90 cents (Toronto price), while 1,000 cubic feet of acetylene burning for one hour would give 53,333 candle power and cost $7.50. Ninety cents worth of acetylene would yield 6,400 candle power as compared with 4,036 candle power given by coal gas; hence acetylene at $7.50 per 1,000 cubic feet is about equal in cost to 20.18 candle power coal gas at 57 cents per thousand feet. Or the comparison may be stated thus, taking the price of carbide to be three cents per pound as in the Wyoming experiment: Toronto gas costing 90 cents gives 4,036 candle power, and acetylene gas costing 90 cents gives 8,000 candle power, the ratio of efficiency being 100:198. This result may or may not be always borne out in actual use; but if ever the cost of carbide is reduced to $20 or $10 per ton, as may be possible when unlimited power is available to generate electricity, there can be then no doubt on the question of relative cost. Inquiry made from some of the users of acetylene however brings out the fact that even under existing conditions it is considered economical as well as satisfactory. Knox church in Goderich may be taken as an example. The plant was installed when the building was re-modelled and enlarged in the summer of 1897. A 60-light machine, including 100 burners, was put in at a cost of $170. The carbide costs 3½ cents per lb. delivered; 17 pounds supplies 82 lights with gas for two hours at a cost of about 55 cents. Since there is a short period of the year when little or no light is required, it is calculated that the expense of lighting the church, the auditorium of which measures 90 feet by 60, is about $25 a year. "The gas," a member of the congregation says, "gives great satisfaction, many expressing the opinion that while the light is a very brilliant, white light, it has none of the dazzling effects felt from electric light, and is much softer and easier for the eyes."

Explosive properties of Acetylene.

The only other point as to which some uncertainty exists is the explosive properties of the gas. In the liquified form acetylene is certainly a substance requiring to be handled with care, but in its gaseous state it does not appear to be much more liable to explode than ordinary coal or water gas. The manufacturers of generating machines say there is but one way in which trouble can be caused, and that is by opening the generator while holding a light in the hand, and then only when the acetylene lights are in use, as generation of gas ceases almost immediately upon the turning out of the lights, owing to the automatic action of the machine removing the water from contact with the carbide. All machines are constructed with a waste pipe running into the open air, so that any surplus gas is conducted outside of the building. Explosions have taken place, but so far as can be learned not in greater proportion than similar accidents with other illuminating gas. One of the previously mentioned

firms states that they exploded about 12 cubic feet of acetylene in a gasometer, and merely succeeded in making a pretty loud report and throwing the gas holder out of the water. "We have frequently exploded smaller quantities," they say, "and in one case exploded about four feet or possibly five feet in a small room in which the ceiling was hung with cobwebs. The cobwebs were not even singed, so we cannot see much danger of fire." The danger of asphyxia is less than with coal gas, for the reason that the burners, which are of a special kind, allow only from half to three-quarters of a cubic foot per hour to escape, while an ordinary coal gas burner passes from five to seven cubic feet per hour. Assuming the poisonous properties of the two gases to be equal, it is evident that the practical danger is much greater in the case of coal gas. Besides this, the very disagreeable and penetrating odor of acetylene would give unmistakable notice of a leak.

Production of Carbide in Ontario

The product of the Willson Carbide Works Company during the thirteen months ending December, 1897, was 574 tons of calcium carbide, valued at $34,440, or $60 per ton, and stated to be the equivalent of 86,053,725 cubic feet of coal gas. Of this quantity 745,817 lb. was exported, and 401,566 lb. was sold for consumption in Canada. The local use of the article is rapidly growing, as the following statement of the monthly sales of last year by the company for home consumption shows:

January	9,361 lb.
February	7,529 "
March	9,018 "
April	3,305 "
May	9,175 "
June	9,920 "
July	8,362 "
August	16,110 "
September	22,660 "
October	95,000 "
November	87,787 "
December	118,125 "

To produce 574 tons of calcium carbide, 768 tons of coke and 903 tons of lime were used, the value of the former being $2,646.37, and of the latter $2,707.39. The average number of workmen employed at the works was 30, and the amount of money paid out for wages during the year was $12,544.62. The works are situated on the old Welland canal at Merritton, and power is procured from the three locks of the canal. The third lock was completed and put in operation January 15, 1898, thus placing 1,200 horse power in all at the service of the works. A short description of these was given in the Report for 1895

Peat Fuel.

The prospect of supplying Ontario with a cheap and good fuel made from the peat bogs of the Province has been referred to in several of the reports of the Bureau, and it has more than once seemed as if the hope of accomplishing this most desirable object were about to be realized. Those who are at all familiar with the history of attempts to manufacture a satisfactory fuel from peat know something of the peculiar difficulties with which such attempts have been beset, and will scarcely wonder if the progress made has seemed slow. Persevering efforts have been maintained by those engaged in the business to overcome defects in the process of manufacture, and the press which Mr. A. A. Dickson, of the Canadian Peat Fuel Company, Limited, Toronto, has recently perfected, gives promise of an ultimate solution of the peat fuel question. As seen at work at the company's office, 110 Adelaide street west, Toronto, this press consists substantially of a solid, upright, iron frame enclosing a geared shaft on which revolve two eccentric pulleys attached to plungers or pistons. With each revolution of the shaft these descend into corresponding hollow tubes or moulds about 12 inches long, and carry with them a charge of powdered peat, forcing it into the tubes under a pressure of about 30 tons. The friction exerted upon the peat by the tubes holds the charge or compressed block tightly in place and prevents it escaping from the open bottom of the tube until another block is formed and pressed down upon it, when it is thrust out a finished piece of fuel in the form of a cylinder two inches in diameter and from two to three inches long. To sustain the great pressure

Canadian Peat Fuel Company. Dickson's Press.

to which they are subjected the tubes require to be made of the toughest and most wear-resisting material. Nickel-steel has been found to combine the necessary qualities where other metals, such as phosphor-bronze, have failed. The only preparation that the peat receives before going into the press is sun-drying on the surface of the bog from which it is cut, and subsequent reduction to powder in a machine resembling the cylinder of a threshing machine, with this difference, that the teeth are not rigid, but are loosely attached to the ribs of the cylinder, thus allowing them to encounter stones or other obstructions without injury. The speed at which they revolve gives them sufficient force to break up the peat. No artificial heat is used at any stage of the process. The fuel thus formed is hard and compact, having a specific gravity slightly less than anthracite coal, and a fuel value claimed to be about equal to bituminous coal. The company own a large bog in the townships of Humberstone and Wainfleet on the Welland Canal feeder, and purpose manufacturing peat fuel extensively therefrom during 1898. They will also make moss litter from the surface layers of the bog, for which purpose a manufacturing plant is already on the spot.

Some experiments with moss litter as a preservative packing material were made in 1897 by Mr. Alexander Jardine, of Toronto. Mr. Jardine made three shipments of fresh fruit thus packed to England, consisting of pears and tomatoes. The first shipment was made in cold storage to Manchester, and turned out very well indeed. The fruit arrived in excellent condition, and meeting a good market it realised a handsome profit. The second shipment was made by freight to Bristol, and though it survived the voyage in fairly good order, was sold at a loss. The third consignment was not in first-class condition on leaving Canada, and when it reached England was totally spoiled, resulting in an entire loss. An objection was made by the merchants who bought the second lot that the fragments of moss and dirt in the fruit injured its sale in competition with the bright, fresh fruit from the continent. Mr. Jardine has also recently made several test shipments of fresh fruit packed in moss to the West Indies, the results of which he has not yet learned. He believes that moss litter as a packing material will be found suitable for tomatoes, the moss fragments not injuring their sale to any appreciable extent, but on the whole is inclined to doubt whether it will prove successful on a commercial scale for the other kinds of fruit.

Experiments with Moss Litter as packing material.

Apatite.

The returns received from the owners of apatite mines show that all of them were idle during the year. At the superphosphate works at Smith's Falls 800 tons of mineral superphosphates was made, the value of which is given as $4,800. The industry gave employment to two men, whose wage earnings were $900. At the same works a large quantity of bone superphosphates is manufactured, and no doubt the amount of apatite required would be much greater than it is but for the fact, as stated by the manager of the works, that the Fertilizer Act operates against mineral superphosphates.

Graphite.

The graphite trade last year did not realize the expectations entertained of it, owing in part to inactivity in the American market and the difficulty of gaining access to it. The Black Donald mine in Brougham township was worked only to the extent of 800 tons, and of this quantity 100 tons was milled at the new works of the Ontario Graphite Company at Ottawa. The industry gave employment at the mine and mill to an average of fifteen men, and the amount of wages paid for labor was $5,000. The graphite, as prepared for the market, is valued at $4,000, and the untreated ore at $3,000, making a total of $7,000 for the output of the mine and mill.

Mica.

Several mica mines were worked during the year, mostly in the way of development, and the returns received show an output of only thirty tons.

A short description was given in the Bureau's report for 1895 of the process by which the Mica Boiler Covering Company,

Limited, of Toronto, convert the scrap or waste cuttings from mica mines and works into material for the covering of boilers, steam pipes, etc., the object being to prevent the loss of heat by radiation. Other coverings made of magnesia, asbestos, etc., are sold for the same purpose at lower rates, but the merits of this article are winning for it an increased amount of business every year Amber and white mica are the varieties preferred, and as the size of the pieces is of no consequence—even the powder made in the course of manufacture being now utilized by a newly patented process—the business provides a market for material which has hitherto been absolutely valueless. About 140 tons of scrap mica were used by the company during 1897, the total value of the goods manufactured being about $10,000. An average of twenty men are employed, the amount paid out for wages being about $4,500. The company state that they are now not only competing successfully with imported coverings, but are exporting their goods to England and elsewhere. Their sales during the last six months of the year exceeded those of the first six months by 128 per cent.

Mica covering for steam pipes, boilers, etc.

Salt and Gypsum.

Eleven salt works were in operation last year, one in Bruce county, six in Huron, one in Middlesex, two in Lambton and one in Essex. The last of these is now the largest in the Province, and gives employment to 70 workmen. The following table shows the quantity and value of the salt production of the Province for the six years 1892-97 :

Production of Salt.

Schedule.	1892.	1893.	1894.	1895.	1896.	1897.
Tons made	43,387	48,450	35,215	51,009	44,816	54,686
Value.....$	162,700	149,850	115,551	188,101	204,910	249,880
Wages	37,800	44,440	43,350	56,496	50,650	58,530

Last year's figures exceed those of any of the previous years in quantity and value, as well as in wages paid for labor. The average number of workmen employed was 210, being 37 more than in the previous year, and the average wage earnings was $279, or $13 less than in the previous year. The average value of salt per ton was $4.56, and in 1896 it was $4.57. In 1893 the average value was only $3.09, but a much larger quantity of dairy and table salt is being produced now than then. The total quantity of fine salt manufactured last year, including table and dairy salts, was 43,468 tons, valued at $212,578 or $4.89 per ton. In 1893, when the production of fine salt was 39,150 tons, the average value was only $3.15.

The production of gypsum last year was only 2,471 tons, valued at $5,491. The average number of men employed at the mines was eight, and the wage earnings paid was $1,940. Nearly all the work was done by contract. In the treatment of raw ore 1,500 tons was converted into calcined plaster, valued at $6,500, and a quantity was manufactured into alabastine and plastico, valued at $11,450. The total value of the manufactured product was therefore $17,950.

Production of Gypsum.

Pig Iron.

The iron furnace at Hamilton was out of blast from the beginning of 1897 until June 28. On that date it was blown in, and the campaign has been maintained to the present time. From June 28 until December 31 the total product of the furnace was 24,011 net tons of pig iron, valued at the works at $288,128 To produce this quantity of iron there was smelted 37,492 tons of ore and 5,350 tons of scale and mill cinder. The quantity of limestone used for flux was 9,473 tons, and the quantity of coke for fuel 27,810 tons. The

Record of the Hamilton blast furnace.

statistics of the furnace for the two years 1896 and 1897 are as follows:

	1896.	1897.
Ore smelted .....tons	51,138	37,492
Scale and mill cinder.... "	5,883	5,350
Limestone for flux..... "	8,657	9,474
Coke for fuel..... "	30,348	27,810
Pig iron product..... "	28,302	24,011
Value of product..... $	353,780	288,128
Wages for labor..... "	47,000	40,000
Average workmen.....	125	130

The quantity of American ore used at the furnace last year was 34,722 tons, as against 35,868 tons in the previous year.

Exploiting for Ontario Ores.

The supply of Ontario ores was procured from the county of Hastings, chiefly from the old hematite mine in Madoc, but magnetic ores are now being taken from the Malone mine on the line of the Ontario Central Railway and from Calabogie on the Kingston and Pembroke Railway. About 2,000 tons has recently been received from the latter place. Some development work was done last year on properties near Desbarats station on the Sault Ste. Marie branch of the C. P. R., but the ore was found to be low grade at the surface and work was suspended until tests can be made with a diamond drill. At the present time a force of miners under charge of Mr. Barnes is opening a deposit of hematite at Algoma Mills. The ore is said to be of fine quality, running 58 per cent. of iron, but no shipments will be made until the season of navigation opens. The ore body lies alongside deep water on Lake Huron.

Copper and Nickel.

By the Canadian Copper Company and the Trill Mining and Manufacturing Company mining and smelting operations were carried on in the Sudbury district last year, the former having three furnaces in blast and the latter one. The furnaces of the H. H. Vivian Company were also in blast, having been rented by Joseph Wharton of Philadelphia, but the mines of the company were shut down. Besides these, work was carried on in the latter part of the year on a copper property in the township of Gould, on the Mississaga river. In September a large location upon which some work had been done by the former owners in 1896 was acquired by Joseph Powers, C.E., of Lansingburg, N.Y., on behalf of a syndicate of capitalists, and in the last three months of the year a force of miners was employed upon it. A camp of six houses was established, an engine, hoisting plant and air compressor were put in at the works, and by the close of the year the shaft had reached a depth of 100 feet on the vein, with drifts of 25 feet each way at the bottom. At the surface the vein has a width of three feet, and at the bottom of the shaft it is eight feet. The ore is said to run about eight per cent. copper, but in places it is much richer. It is the intention of the syndicate to continue sinking and drifting, and, if the ore is found in paying quantities, to build a concentration plant in the spring. There is fine water power on the Mississaga river, convenient to the location, which the syndicate proposes to develop electrically in connection with their works.

Mines and Works in operation.

The following table gives the output of the Sudbury mines for the six years 1892-97, together with the quantity of ore smelted, and the per cent. of its metallic contents:

Ores mined and smelted in the six years 1892-7.

Year.	Ore raised, tons.	Ore smelted, tons.	Per cent. of metallic contents in ore smelted.		
			Nickel.	Copper.	Cobalt.
1892.....	72,349	61,924	3.36	3.19	.1007
1893.....	64,043	63,944	2.21	2.38	.0800
1894.....	112,037	87,916	2.92	3.14	.0721
1895.....	75,439	86,546	2.67	2.73	.....
1896.....	109,097	73,505	2.67	2.54	.....
1897.....	93,155	96,093	2.08	2.86	.....

The quantity of ore smelted last year was larger than in any previous year, and while the percentage of copper is higher than in any year but two of the period, the percentage of nickel is less than in any year. No cobalt has been produced since the closing of the Dominion Mineral Company's works in 1894. The total quantity of ore raised at the mines in the six years is 526,120 tons, and the quantity smelted 469,928 tons. It must not be assumed, however, that the difference of 56,192 tons represents the quantity of ore on hand in the stock piles, as allowance must be made for loss of weight in the roast heaps.

Labor statistics of the Mines and Works.

The next table gives the labor statistics of the mines and works for the same period of six years:

The total amount paid for wages is $1. 393, and the average number of wor employed has been 551, including 11 bet the ages of 15 and 17 who were all emp above ground. The average of wor above ground has been 386 and u ground 165. Under the Mines Act no or woman can be employed at mining in or about a mine, and no boy und years of age can be employed l ground.

In the table which follows compar statistics of the industry are given for th years, showing ore raised

Comparative Statistics of the Industry for six Years.

smelted for each year, matte duct and its metallic contents, value of metals in the matte

Year.	Workers of 15 to 17 years		Workers over 17 years		Total workers.	Total wages.
	above ground.	under ground.	above ground.	under ground.		
						$
1892	10	.....	483	197	690	339,821
1893	10	.....	356	129	495	252,516
1894	17	.....	395	243	655	311,719
1895	7	.....	341	96	444	209,960
1896	8	.....	297	180	485	247,151
1897	12	.....	379	144	535	253,226

For the six years the average rate of wages per year has been $488.62, and for 1897 it was $473.32, or $15.30 less than the average.

puted at the selling price at the w amount of wages paid for labor and av number of men employed:

Schedule.	1892.	1893.	1894.	1895.	1896.	1897.
Ore raised.....tons	72,349	64,043	112,037	75,439	109,097	93,155
Ore smelted..... "	61,924	63,944	87,916	86,546	73,505	96,094
Ordinary matte .... "	6,278	7,176	10,410	12,525	9,733	13,706
Bessemerized matte. "	1,880	452	1,470	103½	.....	328
Nickel contents[2].... "	2,082	1,653	2,570½	2,315½	1,948½	1,999
Copper contents.... "	1,936	1,431	2,748	2,365½	1,868	2,750
Cobalt contents..... "	8½	19	3¼	.....	.....	.....
Value of nickel[2].....$	590,902	454,702	612,724	404,861	357,000	359,651
Value of copper..... "	232,135	115,200	195,750	160,913	130,660	200,067
Value of cobalt..... "	3,713	9,400	1,500	.....	.....	.....
Wages paid..... "	339,821	252,516	311,719	209,960	247,151	253,226
Men employed.....	690	495	655	444	485	535

[2] These are the figures of quantity and value of nickel product supplied to the Bureau by the mining companies, but they are much less than the figures of the Trade Returns of the Dominion Government, which are assumed to be based on sworn statements in the export entries. The owners or shippers of goods consigned to a port or place out of Canada are by the Customs A quired to make entry at the Custom House n to the place of lading of the kinds and q ties of the articles laden by them for export to verify the same by oath. "Such entries, Act reads, "shall specify the kinds and quan of the articles shipped by them respectively

The matte product of the smelters in the : years is 64,061½ tons (59,828 ordinary d 4,233½ bessmerized), being 13.84 per nt. of the ore as delivered to the furnaces. ıe other 405,867½ tons represents the gain freight between shipment in the form of ıtte and in the form of roasted ore. A rtion of it has escaped into the air in a seous state, but the bulk of it has gone to ake the slag pile. The metallic contents of e matte for the six years is computed to be ,568¾ tons, or 25,137,500 lb. nickel, 13,-8½ tons or 26,197,000 lb. copper, and 30¾ ns or 61,500 lb. cobalt. The values, which e based on the selling price of the matte at e works, are $2,779,840 for nickel, $1,034,-5 for copper, and $14,618 for cobalt, or a tal value in the six years of $3,829,178. ıe labor cost of these products, as already inted out, is $1,614,393, which apportioned cording to values would give $1,172,049.32, 4⅞ cents per pound as the cost of nickel, 135,886 or 1⅞ cents per pound as the cost copper, and $6,457.57 or 10½ cents per und as the cost of cobalt—that is to say, e labor cost of producing them in the form matte.

mparative lues of tallic ntents.

The next table gives the comparative values of the metallic contents of the matte based on the selling price at the works:

The prices of both nickel and copper have fallen almost steadily from 1892 to 1897, and these prices bear a close relationship to those of the refined metals. The average of nickel in the six years has been 11.058 cents, of copper 3.950 cents, and of cobalt 23.760 cents per pound in the form of matte, and in the case of each metal the cost of labor is less than one-half—ranging from 42 to 44 per cent.

Where the Nickel and Copper are refined.

The whole of the matte produced at the smelting works of the Sudbury district is sent out of the country to be refined, there being no refineries of nickel and copper mattes in Canada. The great bulk of it at present goes to the Orford Copper Company's works at Constable Hook, N.J., and a small portion to the works of Joseph Wharton at Camden in the same State. The cost of refining cannot be accurately stated, but it is about 9½ cents per pound for shot or plate nickel and 6 cents for nickel oxide, while for fine copper it is about 3½ cents per pound, or about double the labor cost of producing the matte.

Value of the Fine Metal products.

Computed at the present selling prices of nickel and copper in the American markets, the value of nickel and copper produced from the ores of the Sudbury mines in the past six years would be for nickel $8,798,125, and for copper

Year.	Nickel		Copper		Cobalt	
	per ton.	per lb.	per ton.	per lb.	per ton.	per lb.
	$	cents.	$	cents.	$	cents.
1892	283 81	14.190	119 90	5.995	436 82	21.841
1893	275 08	13.754	80 50	4.025	494 73	24.736
1894	238 36	11.918	71 23	3.561	461 54	23.077
1895	174 83	8.741	68 02	3.401	.....	.....
1896	183 22	9.166	69 94	3 497	.....	.....
1897	179 91	8.995	72.75	3.637	..	.....

e total quantity of each kind of article"; and hat the values of such articles are truly stated ording to their actual cost or the value which ey bear at the port and time of exportation." ıe following table compiled from the Trade turns gives by quantity and value the exports m Canada of fine nickel contained in ore, matte speiss in the six fiscal years 1892-97:

1892	lb.	15,233,028	$617,639
1893		8,924,000	427,557
1894		8,411,276	808,799
1895		8,042,586	599,568
1896	lb.	6,996,540	$486,651
1897		7,527,472	498,515
		55,134,902	$3,438,729

The fiscal year of the Dominion ends on June 30, but allowing for the difference of six months between the fiscal and calendar years there is still a very large discrepancy between the returns made to the Bureau and those made to the Department of Trade and Commerce in the six years—those of the latter exceeding the former by more than 100 per cent. in quantity and by nearly 25 per cent. in value.

$2,947,162, or a total of $11,745,287; but for a portion of the period the selling price of nickel has been much higher than it now is.

The American Tariff on Nickel.

Without at all touching the delicate subject of tariff policies, it may be allowable here to note the course of United States legislation on the nickel duties for the past thirty-six years. In 1861 nickel was on the free list. In 1862 it was made subject to a duty of 10 per cent. ad valorem. In 1870 a specific duty of 30 cents per pound was imposed, which in 1872 was reduced by 10 per cent., but in 1875 the former rate was restored. In 1883, under the Morrill tariff, nickel in ore, matte or other crude form not ready for consumption was taxed 15 cents per pound, as was also fine nickel, nickel oxide, or alloy of any kind in which nickel was the element of chief value. Mr. Wharton's mine at Lancaster Gap was exhausted soon after the passage of the Morrill tariff, but diligent search was kept up for ores in North Carolina and other States of the Union, including Missouri and Oregon. In 1890, when the McKinley tariff was framed, the rate on nickel, nickel oxide and alloy of any kind in which nickel was the component of chief value, was reduced to 10 cents per pound, but ores of nickel and nickel matte were placed on the free list. The reason for so doing was subsequently stated by Mr. McKinley himself in these words, made under oath: "It was very doubtful whether we had any considerable quantity of nickel in this country. That is, we had nickel mines in Pennsylvania, the one owned by Joseph Wharton nobody questioned but that it was about mined out, and as there seemed to be none in this country, on the principle we we were framing the Bill we either would put it on the free list or reduce it to a revenue tariff. And I think the Committee were pretty well satisfied that it was very doubtful whether we had any nickel, at least not in quantities in the United States; and we understood that there were great mines in Canada." In 1894, by the Wilson tariff, ores of nickel and nickel matte were put on the free list, and the duty on nickel, nickel oxide and alloy of any kind in which nickel is the component material of chief value was further educed to six cents per pound. The Bill as it passed the House placed ore, ma metal and all alloys of it on the free the Senate made fine nickel and i again dutiable. The Dingley tariff of left ore and matte on the free list a although a strong effort was mad interest of owners of deposits in O impose a duty. Item 185 of the tari "Nickel, nickel oxide, alloy of an which nickel is a component materia value, in pigs, ingots, bars, or sheets, per pound." From this brief reco be observed that as regards nickel matte, nickel alloys and refined ni American tariffs have been studious for the promotion of American inte was only when they could no longe procure the raw material in their ow that they agreed to place ore on the but while doing so they maintained a tory rate upon the refined metal and By the Morrill law of 1883 nickel-a taining only three per cent. of nickel subject to a tax of $300 per net ton McKinley law of 1890 the tax was m per ton, under the Wilson law it per ton, which is continued under the law, and the lowest of these rate hibitory.

Gold.

The working gold mines of the during the past six years supply the

Statistics of six Years.

statistics of men emplo treated, gold product by and values and wages paid for labor

None of the mills connected with t were running the whole year, and on

Operations of the Mills.

three of them ran day a when in operation. The o the Sultana mine was idle for some tin the construction of the new one, a working it treated only low grade o Mikado mill was not started until and the Regina and Foley, while not continuously during the year, were only twelve hours per day. All t mills, except the one of the Canadi fields, Limited, were in operation 1 weeks each towards the end of th Four out of the nine mills are connec mines in which a considerable an development has been done, althou

hree of these it was late in the year ompressor drills were supplied to take e of hand drills in the workings. Yet ur mills show a substantial excess of lue over the cost of labor. In the

Schedule.		1892.	1893.	1894.	1895.	1896.	1897.
lines worked	number	9	15	4	8	8	9
len above ground	"	85	112	40	126	103	222
len under ground	"	40	56	52	111	86	216
re treated	tons	3,710	5,560	2,428	6,500	13,292	27,589
old product	oz.	. . . . .	1,695	2,022½	3,038	7,154	11.412
old value	$	36,900	32,960	32,776	50,781	121,848	190,244
Vages paid for labor	"	22,750	49,027	38,032	56,234	91,210	217,766

ve mines a large amount of develop- ork had to be done, which is properly) against capital, but it is difficult to returns from which a correct classi- can be made of charges against capi- production.

otal quantity of ore treated in the six as 59,079 tons, and the total yield in of bullion is valued at $465,509, being an average of $7.90 per ton. This appears to show that the ore grade, but as in the stages of ment not much pains is taken to he ore sent to the mills, it is prob- at better results will be obtained he mines are efficiently opened up. t that at nearly all the mines, such as ana, Regina, Mikado and Foley, the and workings prove the veins to in- n width as depth is attained, encour- e hope that immense ore bodies are le, and if this is found to be the case age of $7.90 per ton of free milling ore e for the building up of a great gold industry. At the Hammond Reef ere is no doubt whatever of the ex- of an ore deposit of enormous extent, re are several others in the region of per Seine, as well as in the vicinity of f the Woods, near Jackfish bay on perior, in the country north of lake pitae, and in the county of Hastings, h the reports are quite as favorable ie Hammond Reef.

weight of the bullion product is given able only for the five years, 1893-97, three years the average per ton is ,4572 oz. The value per ton in fine gold in the same period is $7.74, and the value of an ounce of gold by the returns is $16.93 or .819 of fine gold. Discussion has taken place recently on the basis to be adopted in publishing the weight of bullion as returned by the gold mills, some writers strongly contending that the only proper basis is fine gold. But there is something to be said in support of the other view. It is worth knowing what the quality or degree of fineness of the gold of any particular mine or of the mines of a district is as determined by its mint value ; and having its weight as produced and the mint value it is a simple matter to calculate the equivalent quantity in fine gold, whereas if the latter only is given with the mint value no calculation can be made of the former.

Weight and value of Bullion.

Only partial returns have been collected of gold properties in process of development, and no estimate can be formed of the cost of the work done. In some cases the labor expended has reached $8,000 to $10,000 during the past year, and the whole amount must be large. The reports of the Inspectors show that development operations have been carried on upon nearly fifty locations.

Properties in course of Development.

Mining Accidents

Mining accidents involving 22 men in all were reported to the Bureau of Mines in 1897, a number much in excess of the previous year. The increase was doubtless due partly to the greater amount of mining and development work being carried on, but also in part to a more general observance by mine owners of those provisions of the Mines Act which require notice of all mining accidents, whether small or great, to be sent to the Bureau of Mines.

General causes of Accidents.

Fortunately the majority were not of a grave character, only one being fatal, while a number were comparatively trivial in their nature. They may be classified as to their importance in the following way: 1 fatal, 9 serious, and 12 slight.

At the Hammond Reef Mine.

On January 15 four men working on Mining Location 318X at Sawbill lake, in the employ of Mr. James Hammond, were injured by an explosion of dynamite, their names being Joseph Drainville, Edward Durahme, William Potreau and Edward Duchon. The men were preparing to thaw out some frozen dynamite in a can or thawer which had been used for the purpose before. It is thought that some nitro-glycerine had run out of the dynamite into the sawdust at the bottom of the can when previously used, and when the supposedly empty vessel was placed on the fire to melt some ice which was adhering to the bottom, an explosion took place. Drainville and Durahme had each one leg broken, while the other two were badly shaken up. cut and bruised. They were brought in from the mine and placed in the hospital at Port Arthur. Potreau and Duchon recovered in a few days, and on 13th April Mr. Hammond wrote that the others had also been discharged from the hospital cured.

At the Craig Gold Mine.

At the Craig gold mine, south halves of lots 4 and 5 in the third concession of Tudor, a miner named Hugh McLeod was struck on the head by a windlass crank and received a nasty scalp wound. McLeod and another workman were hoisting ore out of a shaft with a hand windlass, and on the bucket reaching the top they were in the habit of emptying it and pushing it back into the pit while the rope was slack. On one such occasion the weight of the bucket jerked the crank out of McLeod's hand, he being at the windlass, and coming round struck him on the head with considerable force. The superintendent of the mine had within a few minutes of the occurrence cautioned the men against the practice of throwing the bucket back into the shaft in this way, but they did not pay attention to his warning. McLeod was taken to his home at Bannockburn, and recovered in a short time. The accident occurred on January 18.

On January 28, on the same proj man named Joseph Jackson had hi broken by being struck with a hamm hands of another workman while dril

James McGregor had one of his leg on February 22 whilst prying out c

At the Canadian Copper Company's Nickel and Copper Mines.

roast bed No. 329 in the ro of the Copper Cliff mine, ing his leg jammed betw large blocks of ore. The ceived every care, and on March 20 ported as being well on the way to r

On April 12, in a stope of the Cop mine, a Finlander named August H both his legs broken above the kn was at the bottom of the stope shovel into a tram car when a piece of rock rolled down the side of the pile fro he was loading, and struck him. was of ore accumulated and broke during the preceding winter. Hille received surgical treatment and was t red to Sudbury hospital next morning he made satisfactory progress. I discharged about August 10, walkin crutches, but in the expectation of be to resume work in a few days. W duty he received from the co-operati of the mine benefits at the rate of on per day. This is a fund maintain contribution of 50 cents per month fr of the Canadian Copper Company's en officials and workmen being both in The company contributes to this fund, and allied objects for the w their men, over $400 a year. It is un sole management of the employes, a stated, is highly appreciated by them ally by the married men.

Alfred Dean, one of the Company's was engaged on the eighth level Copper Cliff mine on October 28 sh ore into a mine car when he was stru piece of rock falling from, or supp have fallen from, a point overhead, winze was being put through from the to the eighth level. The piece of rock Dean in the small of the back and infli juries which, though apparently slight proved to be severe. However he ma progress towards recovery, though on ber 17 he was reported as still unable t

r Maaki, a miner employed by the
ın Copper Company, while at work in
th level of the Copper Cliff mine on
9 was struck by a piece of rock
roke his left leg. Inspector Slaght
he mine when the accident occurred,
result of his examination and inquiry
isfied that every precaution in scaling
ting the walls and roofs of workings
n taken by the management of the
The foreman had finished scaling in
ghborhood of the place where the
t happened only at seven a.m. of the
ay, and regarded the spot as safe.
was removed to Sudbury hospital,
ıe made a good recovery.

ıe Deloro mine, owned by the Cana-
oldfields, Limited, Timothy Dady, a
oro miner, while descending to his
work on the morning of April 5,
on the ladders in the Gatling shaft,
l a short distance on to a landing,
receiving any serious injury. The
t was due to his own carelessness. On
0 he was expected to be at work in
r two.

ıe same mine on April 22 an assist-
ill runner named Charles Wellman,
t work in one of the stopes in the
shaft, was slightly scalded by a hose
g becoming disconnected and the
g steam striking him in the face. He
work about a week.

iller named William Davidson, while
in the Deloro mine on May 19, care-
aid his thumb over the end of a drill
holding, and received a full blow
hammer wielded by his partner John
His thumb was badly damaged, but
e serious results followed.

ıe same mine two minor mishaps were
d on June 8, whereby John Mc-
ı received a cut across the back of his
ırough a piece of rock falling upon it
ıe wall of the lode after blasting, and
Froath was scalded in the face by a
ıose attached to a rock drill breaking.
October 5 an employe of the Company
Thomas Christy was struck across the
the hip by a two-inch plank falling a
istance in the first north winze. The
t was not a serious one.

At the Foley gold mine, owned and worked by the Foley Mines Company of Ontario, Limited, a Swedish miner named August Johnson, on May 1 fell from the ladder in the North shaft, a distance of about seventy-five feet, receiving very severe injuries. His skull was fractured, his head otherwise badly cut, and his left leg broken just below the hip joint. The ladders were said to be in perfect order and the air in the shaft exceptionally good. As the Mines Act requires that every footway or ladder shall have substantial platforms at intervals of not more than forty feet, inquiry was made as to the distances from each other of the several landings or platforms in the manways of this shaft. The superintendent of the company stated in reply that between the first and second levels —a distance of fifty feet—the ladder platforms were sixteen and eighteen feet apart. At the time of the occurrence Johnson had just left the second sollar or platform and had climbed, as nearly as could be ascertained, about fifteen feet when he lost his hold on the ladder. His fall would have been stopped on the sollar he had left but for the fact that in his descent he struck a man who was just leaving the second level, which threw him into the skip-road. After this his fall was broken by striking the bearing pieces under the skip stringers, which are about eight feet apart. When he reached the bottom of the shaft, Johnson's fall was broken by about five feet of water in the sump. The man was subject to epileptic fits, and it is believed that he lost his hold of the ladder while in one of these. He was placed under the care of Dr. McKenzie, who on May 21 reported his complete recovery as almost certain.

At the Foley Gold Mine.

In the same mine and in the same shaft on May 25 one of the company's miners named William Robinson, while clearing away a platform preparatory to blasting, broke a plank on which he was standing and fell a distance of thirty feet. Two other men named Anderson and Mattson were also injured, but all three recovered, Robinson in about three weeks and the other two a week or two later.

The only fatality of the year took place at the Olive gold mine, the property of the

Preston Gold Mining Company, on August 20, when a Swedish miner named Gustavus Dahlgrin lost his life under some-

At the Olive Gold Mine.

what unusual circumstances. The facts seemed to warrant investigation, and Mr. J. A. Bow, Inspector of Mines for Western Ontario, was instructed to make due inquiry and report. Mr. Bow's report is as follows:

"I have the honor to report herewith the result of my investigation into the accident which occurred at the Olive mine on August 20, wherein one Gustavus Dalghrin lost his life.

"I made the investigation on December 22, and examined under oath Eric Gustavson, Hans Lennor, Ole Slett, Charles Honeychurch and W. A. Preston, manager of the mine. The circumstances of the case were as follows:

"The accident took place on August 20 last, in No. 1 shaft on the main vein. The shaft was 68 or 69 ft. deep. At a depth of 63 ft. from the surface drifting had been commenced east and west on the vein. The east drift was about 5 ft. in, and the west drift a little more. A ladder way extended from the surface to the 63 ft. level. The ladders were substantial and the rungs all good. I think the top ladder was suspended by a rope and the succeeding ones securely fastened to it so that they were safe for travelling up and down. (I say "I think" because the evidence was not very definite on this point.) The lowest ladder was suspended from the others by a rope, so that it could be hauled up when blasting.

"The mine was being worked by day shifts only and blasting done at six o'clock in the evening. Thus the air in the mine was clear for the commencement of work on the following morning. All work was being done by contract.

"The said Gus Dalghrin and Eric Gustavson were partners working under contract to drift in the east drift at the 63 ft. level. They had been drilling all day and had drilled three holes for blasting, two of which were charged fully and the third with only a small amount of powder for "squibbing," *i. e.*, blasting out a small chamber at the bottom of the hole so that a larger quantity of powder could be put in and a more effective blast obtained. At 5.30 p.m. everyboc come out of the shaft and the blasting wa

"Now Mr. Preston, the manage informed the miners that it was dan to go down the shaft in the evening blast, and that on no account were t do so until the following morning. B withstanding, Eric Gustavson, who evidence stated that he did not think dangerous and did not remember havin told by Mr. Preston not to go down, a partner, Gus Dalghrin, went down 7 p.m. (after eating hearty meals) to the third hole for blasting that same e in order to save time. Dalghrin went ahead. They charged the hole and down but a few minutes when Dalghri sick—the air being very bad. Gust told him to go up while he finished. rin went up the ladder and Gustavson prepared the hole for firing started u shortly after. The latter had got ab or 20 ft. up when he felt a heavy bod ing past him, which touched or gra shoulder. (Dalghrin was about 40 feet the bottom when he fell.) Knowing was Dalghrin, but feeling sick himself tavson continued to the surface. Da was not killed instantly as Gustavson hear him breathing heavily at the bott

"When Gustavson got to the surfa sent Charles Jackson down. Jackson down immediately, and was heard callin help at the bottom. Meanwhile the had spread and all the miners and oth the premises had assembled.

"Hans Lennor, who was employ lander, went to Jackson's assistance. found Jackson trying to get Dalghrin sitting posture. Lennor did not go ri the bottom at first, but only to the Jackson was nearly unconscious. L called to him to give him his hand, whi did after some difficulty, and Lennor him up into the drift, leaving Jackson there in an unconscious state. Mean Gustavson had come down again, but could be of no assistance he returned top and fainted when he reached the su Fortunately Dr. R. M. Simpson of Win was at the mine at the time of the acci and knowing that the men would fai

Yum-Yum Mine. Out-cropping of quartz on G vein, p. 50.

Sawbill Mine. Gold Reef on 314 X, p. 63

Crosscut on the Hammond Dike, p. 65.

g the surface he had made prepara-
› catch them at the top, thus saving
›s of all who could walk up the ladders
).

nnor next went down to help Dal-
He could hear the latter breathing
at the bottom. Lennor's light had
ıt long before this. leaving the place
.l darkness. Dalghrin was sitting
the foot wall of the shaft with his
ɔsting sideways on his shoulder and
ng" heavily. Lennor raised Dalghrin
the drift by means of a plank. The
f the latter was quite limp. Unfortu-
he slid back into the shaft, feet first,
Lennor was preparing to ascend the
. The floor of the drift, it appears,
gently toward the shaft, which was
) ft. below the drift. Lennor put out
ıd to prevent Jackson sliding back
The latter caught Lennor around the
Lennor tried to climb the ladder
is burden, but went six steps only,
ɔk and had to return. He left Jack-
the drift and went to the surface.
› Slett, a miner, went down when
· came up, and found Jackson in the
He took a rope down with him which
around Jackson, and, the other end
ɔope being held at the surface, Jackson
lled up, Slett walking up the ladder
ding Jackson. Dalghrin was evidently
ɣ this time, as Slett did not hear any
ɔm him.

arles Honeychurch, who had just
that day and had taken a contract to
ı the shaft, next went down to get
in. He took a light down but it went
ıoon as the bottom was reached. Dal-
ɣas lying just where he had fallen from
't. He was apparently dead. A rope,
l of which was at the surface. was tied
ip-knot around his body. The body
ıled up, Honeychurch walking slightly
nce up the ladder and holding the rope.
thirty-five feet from the bottom the
ipped through the loop of the rope and
:he bottom. The rope was tied around
st or chest and slipped over the arms
ıd. Honeychurch came to the surface
h air, and went down again in a few
s. This time he tied the rope more
securely and the body of Dalghrin reached the surface without any more trouble.

"Mr. W. A. Preston, the manager, was at supper when the accident occurred. Hearing some shouting he ran out and found the men all running towards the shaft. He went up and saw Lennor, Gustavson and Jackson lying unconscious. Dr. Simpson was attending them. Honeychurch was down in the shaft. Mr. Preston had the bucket sent down with a fire in it to clear away the smoke and gases. The body of Dalghrin was brought up and life was found to be extinct. Dr. Simpson examined it carefully. There was a bruise on the back of the head which was much swollen and other bruises on the face not swollen at all, showing that some of the bruises which must have resulted from the second fall were post mortem.

"Dr D. C. McKenzie of Mine Centre saw the body and told me that he believed death to have been caused by the first fall, as some of the bruises were post mortem.

"I called upon Dr. Simpson at Winnipeg, and his account of the affair was practically the same as I got at the mine. He stated that Dalghrin was not down in the shaft more than fifteen minutes altogether before he was brought up, and Jackson not more than about five minutes. He also stated positively that he distinctly remembers Preston telling the men not to go down in the evening after a blast, and that Eric Gustavson admitted so on being questioned by Mr. Preston on the day of the accident."

At the Stella Gold Mine.

At the Stella mine, mining locations S86 and S87, the property of the Ontario Prospectors' Mining and Development Company, Limited, on December 13 a miner named Uriah Blight fell a distance of 60 feet down the shaft. No bones were broken, but the man sustained a severe shock to his nervous system. It appears that he was down in the shaft some five feet from the surface and standing in a corner with his feet braced on two logs, cutting away some ice which interfered with the hoisting of the ore bucket. From this precarious position he slipped and fell. On December 28 he was reported as being all right save for the violence done to his nervous system, and as expecting to return to work after the New Year.

Mining Roads

There was expended by the Government last year in the construction of mining roads the sum of $32,956, their aggregate length being about 52 miles. The longest of these is the Bonheur and Sawbill Lake road, extending from Bonheur station on the C. P. R. to the gold mines on Sawbill lake. Its general direction is southwesterly, crossing in its way Gull river and passing by Gull, Surprise and Red Paint lakes. The total length is 30½ miles, which has been chopped out 30 feet wide, grubbed 20 feet wide, and graded the whole distance except the crossways on an aggregate of five miles. Three bridges were built over streams, each with a span of 40 feet. To improve the channels of transportation between points on Wabigoon lake and the Manitou lakes, as well as to make easier the means of communication between the C. P. R. and points on Rainy lake, a road of 7½ miles was built from the head of Minnehaha lake, which is connected with lake Wabigoon, to Trafalgar bay on the Upper Manitou. As parts of the same improvement a dam was built across Wabigoon river at Dryden, just above the falls, and another on Manitou river. By the latter work the waters of Wabigoon lake and river are made navigable throughout the summer for a distance of 30 miles, and by the former the waters of the Manitou lakes and river for a distance of 50 miles. The road is the connecting link between the lakes. In the Shoal Lake region on the Seine river about three miles of road was constructed and im from Mine centre towards B million lake, while northwa this lake a road 40 feet wi cut out and graded to Turtle lake, some promising properties are worked. is known as the Rat Portage and Rain road was continued last year from Hil to the Pine Portage mine. deal of traffic passes over it mines, and it will proba extended at an early day to Long Lak rows. About five miles of road was al structed leading out from Rat Por mines and mining lands in the dire Rossland, known as the Rossland roa the north shore of lake Superior the J Bay and Long Lake road v tended a little over three while near the village of Sc a bridge was built over a deep ravine t easy means of reaching mining and lands in that vicinity. The cost of several improvements is given in the ing table :

Bonheur and Sawbill road.....$19,
Wabigoon and Manitou works.... 8,
Shoal Lake road.....
Turtle Lake road..... 1,
Road to Pine Portage mine.....
Rossland road.....
Jackfish Bay road.....
Schreiber bridge.....
Total..... $2,

Appropriations of $15,000 have beer for the construction of mining roads thi

Bonheur and Sawbill Road.

Mine Centre to Turtle Lake.

Roads out of Rat Portage.

North of Lake Superior.

Communication from C. P. R. to Rainy lake.

Mines of Northwestern Ontario

By James A. Bow, Inspector

Introduction

I HAVE the honor to present hereby my first annual report on the Mines of Northwestern Ontario. The report embraces all working mines and nearly all locations where more or less prospecting or developement work is going on or has been done. As I travelled the first part of the summer in company with Dr. Coleman and Prof. Willmott, who were out on geological work for the Bureau, a number of places will be included in their reports which will be only lightly or not at all mentioned here. It would be impossible to include in this report all locations where operations are going on, as we are continually hearing of the commencement of testing or developing in some new place, and within the past two or three months there have been a number of such that have not been visited by me.

So far the prospects of the country have been improving. New sections are being opened up and developed, and the older sections in most cases give no reasons for discouragement. The Lake of the Woods country still stands in the front with the largest mines and mills. Gold is being found in a number of new places there, such as on Camp bay, Shoal lake, etc. And although a few of the mines give discouraging results, the larger ones such as the Sultana, Regina and Mikado, which have the most extensive developing, appear to be improving. The Lower Seine river country received a little set back when some of the mines there closed down, but now things are looking more encouraging than ever. The Foley mine is looking best between the 200 and 300 foot levels. Several new mines have opened up, such as the Olive, Golden Star or Randolph and AD2, and there is no doubt that the Lucky Coon and Ferguson will soon commence operations again also. I am told that work is going on in a number of places on the Seine between Shoal and Sawbill lakes, and also east of the Sawbill. The Sawbill country holds its own. This, like all other parts, will require time to prove its value; but it looks as if, with the big Hammond Reef, it would have a very bright future before it. Prospecting has been going on in the Shebandowan section, but not much can be said about this place yet. All of these regions have some, if only one or two, properties that will pay well; but when it is considered how little is really known of what is under the ground, and in fact on the surface too in most cases, it seems foolish to jump at any conclusions. The Manitou country received a "black-eye" when the mines there closed down, but the people in that section are not discouraged. There are some good veins there, and there is no reason why it should not be quite equal to the other sections of the country. There is work going on in several places, and the Neepawa mine will be opened again right away. The fact of a mine or a number of mines closing down at any place is not necessarily a reason for discouragement, as there are so many reasons for their so doing, and it has seldom been the case that it has been done from the fact of the vein playing out. A new section south of the railway track, between Tache and Brulé, of a few square miles in extent is being prospected and developed, and gives very good promise. North of the track in the Lac Seul and Minnietakie regions a number of locations are being taken up, and according to reports that will prove to be a very good country. The Jackfish country north of Lake Superior received a set back also on account of the Empress mine closing down, but it was certainly not from want of ore that it did so, and according to reports it

will start up again in the near future. The old Silver mining region at Port Arthur is beginning to show signs of life again. Some work is being done at a couple of the mines.

As I stated before, I made my first trip over the country with Dr. Coleman and Prof. Willmott. We left Rat Portage on June 10 by canoe and visited all the mines on the Lake of the Woods that were then in operation, finishing up and returning to Rat Portage on June 30. We next took the train to Wabigoon, and after Dr. Coleman and I visited Dryden to look at some properties we left Wabigoon by steamer on July 6 for the mouth of the Litt'e Wabigoon river, which flows into Little Wabigoon lake. From this point we took to our canoes again and voyaged up the river to Long lake, across several portages to Big Turtle river, and down the latter to the Seine. We visited the working mines in that section and then continued up the Seine to the Sawbill country and from there to Savanne, arriving at the latter place on July 22. We took the train to Fort William that night, stayed there for a day or two, and continued east. Dr. Coleman went through to Sudbury, while Prof. Willmott and I stopped off at Schreiber and Jackfish to visit the mines at these points. Prof. Willmott left me at Jackfish, where I stayed for several weeks, in the meantime visiting some locations in the neighborhood. Receiving instructions to make another tour of inspection, I went to Rat Portage again, and on September 7 left by canoe, making another trip over the Lake of the Woods, and returning on September 22. I then went to Savanne and with two canoemen made the trip down the Seine river to Shoal lake, leaving Savanne on October 9, and visiting the Sawbill and other places on the way. Having finished at the Seine river country, I started for Wabigoon by way of Rainy and Manitou lakes, with only one canoeman, arriving there on November 2. I stayed there for several weeks, visiting some places in the neighborhood during this time, and then took the train to Fort William, where a couple of the old silver mines had commenced operations. Returning to Bonheur, I made the trip to Sawbill and return by stage, and continued west to Rat Portage, stopping two days at Wabigoon on the way. December 16, desirous of going to) Centre again, I took the train via Winn and Tower, and the stage from the la point, which is two days journey from) Centre. Returning the same way I arr in Rat Portage on December 31. On Ja ary 19 of this year I went out to the Re mine by stage and returned on the 21st.

The larger mines, as a general rule, I are in a pretty safe condition, the mana comply ng satisfactorily with the Mines . Copies of the latter were left at all the pl I visited, and the Inspector's Books at principal mines.

Lake of the Woods Min

My first object of visit was the Hay Isl mine, situated on the eastern side of the l

Hay Island Mine.

arm which stretches north from l island, in the Lake of the Wo This is an old mine, originally known as Keewatin. Two shafts had been su one near the shore, now completely s merged during high water, and anoth few hundred feet back on high ground. Th shafts are said to be on the main vein. former exposed at the bottom a 4- quartz vein, but in the latter the vein aver less than a foot in width. The mine is owned and worked by the Hay Island G Mining Company. Mr. John Kenty is m ager. I visited the place on June 10 and September 7, and found work progres favorably.

There are two veins on the property, called the main vein, and about 200 feet w of it a parallel vein running N. 20° which the manager believes joins the for at some point to the northeast. The m vein has been traced for about 50 yards r the shore, and what is believed to be the s has been stripped and traced for 100 f about 300 yards farther in. It ranges fr six to 12 inches in width. The manage not sure that this is the same as the foot vein exposed at the bottom of the submerged shaft, but is working with expectation that it will prove to be. A vert shaft is being sunk on a line between the

hafts for the purpose of proving the con-
.tion. It will be sunk 100 feet, and cross-
ng will be carried on east and west. On
ember 7 the shaft was down 64 feet.
e branch vein has been traced about 50
Two test pits several feet in depth have
sunk upon it, and a little stripping
The vein is rather irregular, but shows
; 18 inches of quartz.
'isting is done by horse and whim. There
) miners employed, and work is carried
y day and night shifts. The shaft is
:red at the surface and properly fenced.

Dominion Gold Mining Co.

ɜ Gold Hill property lies east of Big
ɜ bay. This mine has been mentioned
ill in previous reports and will not be
dwelt upon at length here. It is
l by the Dominion Gold Mining and
ction Company.
June 11, at the time of my first visit,
niners were employed in opening up the
ination vein, which had been recently
'ered It is situated about a mile south
ɜ former workings. This was the only
where work was going on at the time.
est pits were being sunk about 50 feet
; one was 15 feet deep and the other
eet. The vein was four feet wide on the
e and consisted of green schist and
: mixed. It was very rich in free gold.
'rations were discontinued on this vein
weeks after, and work on the Pebble
ommenced.
my visit of September 8 all work was
ıtrated in sinking a shaft on the latter
It is six by eight feet in size and has
d a depth of 115 feet. The first level
eet from the surface. A drift has been
est 23 feet along the vein, and another
l feet. The second level is 115 feet
and at this point a fork is being driven
was 11 feet in at the time of my visit.
vein in the shaft varied in width from
18 inches, and consisted of quartz mixed
considerable amount of country rock.
p of the vein is nearly vertical at the
ɜ, but gets flatter with depth.
shaft is timbered to a depth of 12 feet,
bstantial ladders with iron rungs are
ed.

The smoke and gases after a blast are cleared out by air which is forced down through a canvas tube by means of an air blast.

A Hughes pump with a 3-inch intake was ready to be taken down the shaft as soon as the sump was sunk. A small steam hoist and a boiler of 15 or 20 horse power, which furnishes power for the hoist and air blast, completes the machinery list. The old mill with all its machinery is still on the property, but has not been running for some time.

Four miners were employed in September under manager Charles Smith.

Work has been discontinued at the Black Jack mine, which adjoins the Gold Hill property and belongs to the same company, viz., The Dominion Gold Mining and Reduction Company of London.

Black Jack Mine.

I had an interview with Mr. Alexander M. Hay, president of the Dominion Gold Mining and Reduction Company, on January 24, and got the following notes from him: All work on the Black Jack and Gold Hill properties has ceased. In the fall of 1897 diamond drilling was done at both places, but without any satisfactory results. A bore crossed the Black Jack vein at a vertical depth of about 300 feet, and one crossed the Pebble vein at a depth of about 350 feet, but the veins at these depths were small, as at the surface. Diamond drill testing has also been carried on lately at the Sultana Junior property, which belongs to the some company. The vein was crossed at a depth of 280 feet, but results were not satisfactory. Some more boring may be done here in the future, but the Black Jack and Gold Hill properties will probably be given up.

Later notes on the Dominion Company's properties.

The Rat Portage Reduction Works are now managed by Mr. Hay and are open for business as usual. No alterations have been made in the machinery.

Rat Portage Reduction Works.

Golden Gate Mine.

About three-quarters of a mile from the Gold Hill camp, and connected with the latter by a good waggon road, is the Golden

Gate mine. This property originally belonged to the Dominion Gold Mining and Reduction Company, but has been bought and is now worked by Mr. W. A. Laycock. There are a number of veins on the property which have been tested more or less.

Golden Gate Mine

On June 11 operations were going on in one shaft only. It had then reached a depth of 60 feet. Thirty feet from the surface a level was driven along the vein 20 feet west

On my visit of September 8 I found that work had been discontinued in this shaft. It was then 63 feet deep, and the drift had been driven 69 feet altogether. There is four or five feet of vein matter shown in the shaft, consisting of quartz and green schist, and an 18-inch pay streak. The water is kept pumped out to the bottom of the drift with the expectation of commencing work again soon. Meanwhile two other veins on the property are being tested.

About a hundred yards north of the main shaft is a vein on the contact. It is from 10 to 20 feet wide and consists of large parallel quartz stringers alternating with bands of green schist. It has been traced about three-quarters of a mile. Test pits have been sunk in three places, and one of these is being continued.

The other ore deposit is a felsite dike five or six feet wide, which has been traced about half a mile. It is in the schist and runs with the formation, which has a strike of northeast and southwest. A test pit is being sunk upon the dike.

The force consisted of four miners and two surface men.

There is a comfortable boarding camp on the property, besides two or three other buildings.

Mines near Andrew Bay.

The Stella mine, owned by the Ontario Prospectors' Mining and Development Company of Rat Portage, consists of locations S86 and 87 east of Andrew bay, on the eastern side of the Lake of the Woods. Mr. Neil Campbell, manager of the mine, has been employed with a force of men all summer developing the property. I visited the place on June 11, and again on September 9.

Stella Mine.

There are several veins so far known, t of which are being developed. The mai Stella vein is a pyritiferous vein of qu containing a little green schist. It ra from two to four feet in width, and has b traced about a mile and a half. The st is nearly east and west and the dip south. It crosses both locations.

There are one or two smaller parallel v north of this vein, one of them about 20 f distant.

The country rock at these veins is t but the contact with the granite occu short distance to the north.

A few hundred feet north of the St vein is what is called the Contact vein, is believed to be on the contact of the mations. It is from 16 to 20 feet in wi and has been traced about a mile an quarter. The strike of the vein is a degrees south of east, and the dip ne vertical The vein matter is green schist quartz, pretty well mixed and charged v pyrites.

On the Stella vein a shaft is being s which has reached a depth of 38 f The vein is nearly vertical at the surf but at a depth of 20 feet dips sudde to the south, and five feet farther down les the shaft altogether. It does not pinch h ever. The shaft will be continued stra for a depth of 50 feet, and crosscuts will t be driven to the south and north in orde cut respectively the main vein and the sma one upon the north side which dips tow the shaft.

The shaft is on S87. On S86, abou quarter of a mile west of the shaft, where ground rises into a steep hill, an adit been driven 35 feet west into the same v The vein varies from a width of two feet the entrance to three or four feet at the e This adit has been discontinued.

About 50 feet of stripping has been d on the vein between the shaft and the a The covering material is principally loose r and earth, with a thick growth of small tr

On the Contact vein a shaft eight by feet in size has been sunk to a depth of feet.

ıt a quarter of a mile west of this shaft ıs been sunk to a depth of seven feet. ras done last March, but work was ned on account of water a vugh having ıpped which filled the pit. It is ex- that operations will be resumed at the ıpening, as a large amount of quartz is at this point on the vein.

large shaft on the Contact vein is not ıfe condition, and the necessity was l out of having it securely timbered surface before sinking is commenced

Instructions were also given to have built around the shaft on the Stella Copies of the Mines Act were left he manager. There are nine miners ed, working day and night shifts. g is done by contract at $20 per foot first 50 feet. The shaft is eight by t outside the timber.

old Jenny Lea camp, which is on an ng location, has been used by the t company so far, but it was their inten- erect camps of their own very shortly. ıod wagon road three and a quarter ong runs from the mine to the landing drew bay, from which point steamers n to Rat Portage, 18 miles distant.

ın interview with Mr. Campbell, the er, early in January of the present learned that the main shaft has been 65 feet, and 30 feet of cross-cutting o the south.

ther property near Andrew bay is known Triggs mine, which was acquired by the Triggs Gold Mining Company of Ontario in the month of October. n that development work is being y carried on there with a force of eight ı, but I have not had an opportunity to ; yet. The property consists of three ıns aggregating 113 acres.

Gull Island.

ır leaving the Stella mine I started for sland, where I was told some work was going on, arriving there September 10. Five miners were at work g a shaft by contract. I was not able ıtain any definite information there the company or their intentions, but the following notes :

This mine is situated on the southern extremity of Gull island, north of the Grande Presquile, and consists of location K65. It is an old property, having been discovered a number of years ago, and a little work had been done before the present company commenced operations last summer. The country rock is a soft, clay slate. There are four or five veins known so far, which are all parallel and run with the strike of the slate, which is a few degrees north of east. They are close together and cut across the point of the island. The dip is nearly vertical in each case and good clear walls are shown as far as they have been exposed. The vein matter is a quartz porphyry principally, but more or less quartz is contained, occurring as stringers of various sizes, and sometimes taking up the whole width of the vein. The ore bodies are no doubt eruptive dikes, and the quartz a subsequent deposit.

The two most northerly veins are about 15 feet apart. The more northerly only outcrops in one place, but shows a width of 10 or 12 feet. The covering material is moss and trees, which give considerable trouble in stripping. The other is the main vein It is traceable for a distance of about 450 feet, outcropping in two places only. The third vein to the south can be traced about 400 yards. It has been uncovered in several places, and shows a width of from four to six feet, with good walls. The fourth vein, 20 or 30 feet farther south, outcrops in two or three places and doubtless cuts across the island also. It is from seven to eight feet in width. This is a new vein, having been discovered last August.

About 125 feet above the lake, and 150 feet inland, a shaft is being sunk on the main vein. It is 6½ by 10½ feet outside the timber, and was forty feet deep on September 10. The work is being done by contract, the first 50 feet to be sunk at $25 a foot. The width of the vein varies from six feet at the top to eight feet at the bottom. There is a two-foot pay streak of quartz at the bottom, rich in galena and zinc-blende. Timbering has been carried to a depth of 10 feet. A horse and whim are used for hoisting.

There is some old work on the property which was done last winter by the former

owners. At the east end of the veins the rock rises in a steep bluff from the water. Near the level of the water a tunnel has been driven west along the first vein for a distance of 60 feet. There are a log boarding camp and a couple of tents on the property for the accommodation of the men.

Bath Island Mine.

The Bath Island mine, owned by the Bath Island Mining Company, Limited, of Toronto, consists of locations 504 and 589P. This island is north of Cliff island, which is north of the Grande Presquile. Like Gull island, this property was discovered a number of years ago, and is similar in nature to it. The formation is a clay slate, and the ore bodies consist of a series of parallel dikes of porphyry, containing more or less quartz as stringers. They run nearly east and west with the strike of the schist.

Bath Island Mine.

I did not examine more than two or three of the veins; but got some general information from the foreman who was in charge at the time.

There are said to be 19 veins altogether, which average five or six feet in width and can be traced considerable distances. More or less test pitting and stripping work has been done on all of them.

The main vein is the second one from the south. It can be traced half a mile or more. A shaft 6½ by 10½ feet outside the timber is being sunk upon it. It was 84 feet deep on September 10. The shaft is sunk directly on the vein, which is practically vertical. The work is done by contract, the terms of which are to sink 100 feet and then crosscut 150 feet to the south and 100 feet to the north. There is a large vein called No. 2, which it is expected will be cut by the north crosscut. The vein varies in width from eight feet at the top to five feet at the bottom, and is three feet at the narrowest place in the shaft. The shaft is well timbered for a depth of 40 feet, and a manway cased off for the same distance. A hoister from Beatty & Sons, Welland, driven by a horse, is employed in raising the bucket.

About a quarter of a mile west of the main shaft on the same vein a shaft had been sunk about two years ago to the depth of 20 feet.

About 50 feet east of the main shaf is an old test pit 20 feet deep on th vein also.

There are nine miners employed in d night shifts—four in the former and the latter.

The buildings consist of a cooking blacksmith shop, powder house and office. There is also a neat and roomy house over the main shaft, and the way is properly guarded at the surface

The agreement in the contract is t the first 100 feet at $29 50 per foot, w privilege of doing the next 50 feet same rate. This includes timbering, l and putting in ladder ways; the co furnishing the timber and lagging, and ing and hoisting machinery.

Mr. Allan MacDonald of Rat Portag is the contractor, told me on January work was still going on. The shaft ha sunk 101 feet and discontinued. The now working in the crosscut, which ha driven 43 feet north from the bottom shaft. They expect to cut No. 2 v feet from the shaft.

At the Passage.

Southwest of the Passage to Wh bay on the western shore is the prope H190, a location of 57 acres by Messrs. Morris, Kennedy daur and Bates of Rat Portage. I visit place on August 28 and again on Septem

Location MH 190.

The formation here is hornblende and trap, the contact with the granite close by to the southwest. The ore d consist of fahlbands, or parallel ba hornblende schist mixed with a dark porphyry, and a proportion of scattered all through it. More or less p is contained, and the material is a litt dized near the surface. There are sev these fahlbands close together, averag width from 12 to 20 feet apparently. B much stripping has been done yet, and extent has not been accurately determ The main vein can be traced for a quar a mile. It outcrops at the shore and a width of 12 feet. There are severa pits along the vein, and a shaft of sev 11 feet is being sunk about 250 feet fro

shore. It was 15 feet deep on September 11. A little test pitting has also been done on the vein to the south.

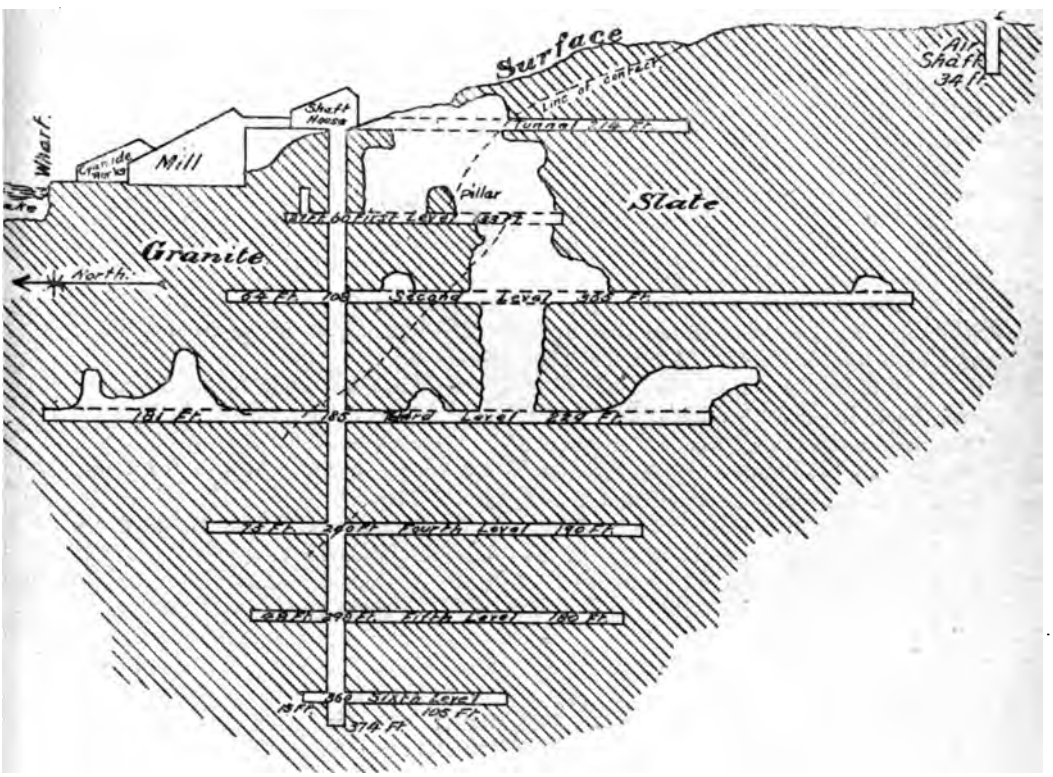
Work commenced here in the latter part of July. A force of six miners has been employed under Mr. George Bates as manager. It was at the shore where the main vein outcrops that the first signs of gold were found, and a little quarrying has been done here.

Mr. Morris told me recently that operations had ceased for the winter. The shaft had been sunk to a depth of 36 feet. The amount of quartz he said had increased towards the bottom, and the vein was richer.

following summary from the entries in the Inspector's Book gives the amount of work which had been done on the property up to September 11.

There are four shafts altogether; the main shaft, six by 10 feet in size and 343 feet deep; the air shaft (400 feet south on the same vein) 34 feet deep; and the shaft on the west vein and Camp shaft, 72 feet and 18 feet deep respectively. The last three shafts are old work.

Details of the Workings.



Regina Mine, Jan. 20, 1898. Longitudinal section of main shaft.

The Regina Mine.

I visited the Regina mine on June 24 and on September 11. This mine is being rapidly developed and the vein seems to be improving with depth. The management has been transferred to Mr. Henry A. Pringle. Full accounts of the mine were given in previous reports of the Bureau. The

Three chains east of the main vein is a parallel vein called the Magazine vein. It has been stripped for a distance of about 50 yards up the face of the hill. It averages about nine inches in width. An open cut about 30 yards long and of an average depth of eight feet has been made on it.

The following is the extent of workings in the main shaft, including the tunnel. The latter, which is driven south on the vein from the mouth of the shaft, is 214 feet long, and has been discontinued. Sixty feet from

the surface a level has been driven south 133 feet and one north 27 feet. One hundred and eight feet from the surface a level has been driven south 355 feet and one north 64 feet. One hundred and eighty-five feet from the surface a level has been driven south 229 feet and one north 181 feet. Two hundred and forty-eight feet from the surface a level has been driven south 91 feet, and one north 75 feet. Two hundred and ninety-eight feet from the surface a level has been driven south 49 feet, and one north 31 feet.

Stoping has been done in the first, second and third levels and in the tunnel. In the latter nearly all the ore has been stoped out overhead for a distance of 80 feet south, leaving sufficient for the support of the surface. In the first level stoping has been carried up to the tunnel for a length of 120 feet. In the north drift a 25-foot raise has been made. In the second level south for a distance of 70 or 80 feet along the vein the ore has been stoped out overhead up to the first level. A little stoping has also been done near the shaft, and near the south end of the same drift. In the third level north the ore has been stoped out overhead for a distance of 110 feet and with an average raise of about 18 feet. In the south drift a little stoping has been done in two places near the centre; and at the south end the ore has been stoped out for a distance of 60 feet, with a raise of 27 feet.

With the exception of the cyanide works no change has so far been made in the machinery. For drilling there are two air compressors and three machine drills. For hoisting and tramming there are a hoisting engine, two buckets, three cars and four trucks. For milling there are a Blake crusher, two five-stamp batteries and two Colorado Perfection concentrators. Power is supplied by three boilers and a steam engine. A cyanide plant, according to the McArthur-Forrest patents, has been installed for the treatment of the concentrates and tailings. It was completed and put into operation about the first of January, 1897. The capacity is 600 tons of tailings per month and two 10-ton vats of concentrates.

Machinery and Cyanide Plant.

The main shaft, including the manway in a suitable condition as regards saf Stopes are properly secured with timbe and fencing. Other shafts are covered danger notices posted up. The machiner the mill is all properly guarded. The t force of the mine consists of 40, inclu 12 miners.

Mr. Pringle intends building a new entirely in the spring. It will be a 40-st one, or its equivalent in Tremaine s stamps. A Tremaine two-stamp mil to be installed right away, and wo all winter for experiment. If satisfact gravity stamps will be dispensed altogether. The foundation for the maine stamp was being prepared during last visit; it will be placed alongside old battery. The new mill will hav different site; it is to be built on a gr spur which juts out into the lake, clos the old one.

The mill and outside works are lighte electricity.

Since last year a new blacksmith shop a reading room have been built.

A steamboat named the Squaw, owne the company, runs between the mine Rat Portage.

Recent progress at the Mine.

On January 20, 1898, I visited the again and made the following notes: The shaft has been sunk to a total d of 374 feet. No drifting has done in the first, second or third levels sinc inspection. The fourth level has been dr south 190 feet altogether. The south dri the fifth level has been driven a length o feet, and the north drift 48 feet. At a dist of 360 feet from the surface a sixth level been established. The south drift is feet, and the north drift is 15 feet. Ei feet from the shaft in the third level sou stope 30 feet long has been carried u the second level. A stope 100 feet lon been commenced in the fifth level south, will be raised to the third level. After only the fourth and sixth levels will driven (both directions) and the second south, so that the mine will be worke practically 120-foot stopes. The second will be driven south indefinitely and a c cut made from it east towards the air s

.tter will be connected by a raise from
scut. The air shaft will then be con-
ertically, crosscutting to the fourth
h levels, and used as the main shaft.
)e in the second level is being tim-
/er for the laying of tracks to be ready
.bove work.

ein in the mine varies in width from
ıe to nine feet. It is much larger
lower levels than in the upper, and
lso. In the stope known as the third
.ise it averages five feet wide, and in
)-foot stope commenced in the fifth
averages six feet. It averages about
:et from start to finish in this latter
ıd is nine feet wide at one place. In
h level it runs from one to five or six
width, and only one wall reached at
est place Very little visible gold is
ı the vein, and the percentage of con-
:s is low.

ıange has been made in the hoisting
ng machinery, but the concentrators
ıill have been done away with until
/ mill is built. and the Tremaine steam
ıill is in place and running. The cyanide
ıre the same and are in continuous
)n. The condition of the mine is
ıtisfactory. The force has been in-
by four miners. A couple of pros-
have been working on the locations
mer. The main vein has been strip-
it and some test pits sunk. It has also
raced a couple of hundred yards

Sioux Narrows.

s told that at the Sioux Narrows,
trance to Regina bay, some work
had been done on a property
owned by the Bertram Iron Works,
of Toronto. I visited the place
)tember 13, on my way from the
mine, but found nobody there,
:nce could get no information. I
inland a bit, and following a well
trail came to a shaft about 150 yards
ıe water. It was about 40 feet deep,
ık on the vein. The vein, which runs
ł west, consists of quartz and felsite
very pyritiferous. The walls appear-
e indefinite

Trojan Mine.

The Trojan mine is situated east of Atinimikie bay (or Grassy bay, as it is locally called), which is a small bay on the southeastern side of Whitefish bay. The landing place is in the former bay, and a trail of about one mile leads to the mine. The property consists of locations 77S and 3 and 4 WA, aggregating 120 acres. It is owned by Messrs. C. Stirling, T. Walsh and M. P. Wright, of Rat Portage I visited the place on June 23 and again on September 13.

Trojan Mine

The country rock is granite and trap. There are seven veins on the property. On locations WA3 and 4 there is a steep hill of trap which rises to a height of several hundred feet. On the top of this hill is No. 1 vein, which has been traced six chains. A shaft has been sunk 30 feet on it, but discontinued. Several test pits have been sunk on some of the other veins on the top of this hill.

About half way down the face of the hill is No. 2 vein, which has been traced five or six chains. A shaft was being sunk when I was there, and had reached a depth of 67 feet. Drifting has been commenced to the east, at the bottom. The vein showed splendidly at the top, being from 18 to 24 inches wide, and continued so for a distance of 25 or 30 feet, but began to pinch at that depth and at the bottom is only a few inches in width.

The force consisted of three mine s, a cook and a blacksmith.

I met Mr. Wright in Rat Portage recently and he told me that at the bottom of the hill a new vein (No. 3) had been discovered, and that it was a contact between the granite and the trap. It had been traced 12 or 14 chains and was about six feet wide. Work has ceased at the mine, as it has just been sold.

Mascotte Mine.

On June 23 and on September 13 I visited La Mascotte mine. It is close to the Trojan, being reached from the latter by crossing a small lake one-third of a mile wide. It is owned by the Colcleugh Gold Mining Company of Rat Portage. The property consists of location S79, which contains a little under 50 acres.

La Mascotte Mine.

The location is bounded on the south by the lake mentioned above. A short distance from the lake the ground rises steeply to the north to the height of about 100 feet. The formation here is hornblende schist and granite, the contact with the granite coming in to the north about 100 feet back from the face of the hill. The strike of the contact is east and west. The schist is very irregular in general structure. This is manifested particularly in the appearance of the veins, which cannot be depended upon for continuity, especially near the surface. The strike is very irregular, and the thickness of the veins extremely variable. But it is expected that more regularity exists at a greater depth, and the richness of the veins at present warrant for a thorough test.

There are four veins on the property, three of which are quartz veins, and the fourth a large dike containing felsite and quartz. The quartz veins all run roughly east and west and dip slightly to the north.

No. 1 vein is farthest north. It runs up over the top of the hill. In width it varies from three or four inches to five feet, and can be traced for 300 or 400 feet. The vein matter is a fine grained white quartz, with a little country rock mixed in, and slightly pyritiferous. No. 2 vein runs along the hillside south of No. 1. It is only a few inches wide, but can be traced for 200 feet. No. 3 vein, which is at the bottom of the hill, has been traced for 50 or 60 feet. No. 4 vein is on the west side of the property. As stated before, it consists of a large dike of felsite and quartz, running north and south. The walls were not uncovered, but it is over 20 feet wide. It runs through the granite.

Work on the Veins.

On the top of the hill a shaft has been sunk on No. 1 vein to the depth of 35 feet. The vein was five or six inches wide at the top, widened out to about five feet near the bottom, and then pinched out altogether within the next three or four feet. Work on this shaft has been discontinued. About 25 feet east of the shaft a test pit has been sunk four feet. Fifteen feet west of the shaft a test pit has been sunk six feet, and about 40 feet farther west a shaft has been sunk on the hillside on the same vein. Near the bottom of the hill a tunnel has been driven t feet. This was intended to cut No. which it did at 60 feet from the e Seventy-five feet from the entrance cut has been driven eas 31 feet, intention of again cutting No. 1 v without success, and it is believed t vein changes in direction after it cr tunnel and runs parallel with the c whereas it was running northeast in nel. Sixty feet from the entrance tunnel a winze is being sunk, and w 11½ feet on September 13. Mr. Kel manager, thinks the formation will regular at a greater depth, and int sink this winze until the vein impr siderably, and then drift along the wards the granite. The vein is on inches wide where it crosses the tu is two feet wide in the winze. No been done upon No. 2 vein, except a of stripping. This vein runs more west than No. 1, and appears to latter where the tunnel is driven. has been sunk on No. 3 vein to the 43 feet. The vein was four feet wi surface, and the dip to the north, the bottom the dip changed sharpl south, and the vein pinched to two inches, hence work was discontinue vein, like the others, is very rich, considerable free gold. A few sh been put in on No. 4 vein to g samples, but practically no work done upon it. There is a force of si at work.

The buildings consist of a powde blacksmith shop, store house, cool sleeping camp and manager's dwellin is no wagon road leading to this or th mine. All supplies have to be packe a trail about a mile long from Atinini

Recent Work.

I met Mr. C. P. Kelpin, the mar the mine, in Rat Portage on Januar he gave me the following the work at the mine up The winze in the tunnel was sunk 14 discontinued. All work is now conc on No. 3 vein. The shaft was c again, and sunk another seven feet, it 50 feet altogether. Forty feet f surface a drift has been driven on the

i being continued. The vein runs
.ches at the entrance to two and a
.t the end of the drift, and is very
:e gold. But it disappeared alto-
r the last eight or 10 feet in the
iich has been going through the
r that distance.

et west of the shaft a costean has
through six feet of gravel to bed
the purpose of finding the vein,
i been reached. The vein is all
y this gravel west of the shaft, and
onsiderable trouble to expose.

act has been made with J. Burley
the testing of No. 3 vein with a
lrill. The testing is expected to
: right away.

On Camp Bay.

half a mile north of Camp bay in
bay is a property which has been
:pened up within the past few
months and has been creating con-
iensation. It is known as Sullivan's
visited the place on September 14,
l work being pushed vigorously.
irty consists of locations 56, 57 and
240D, aggregating 190 acres. It is
M. P. Wright, C. Stirling and T.
Rat Portage. It was discovered by
'right in August, 1896. A. B.
l and Alan Sullivan of Rat Portage
red a twelve months' option on it
agreement to do a certain amount
)ment work. The country rock is
st and trap, and the contact with
e, the strike of which is north and
urs about 50 yards east of the ore
ie ore body, which for simplicity is
ein, is in reality a large dike con-
site and quartz, the latter occurring
n the felsite. It ranges from four
: in width and has been traced over
ne say over seven locations. The
orth and south, which is the same
the schists.

)ns commenced on July 3. A little
ias been done here and there and
several test pits sunk along the vein
:o discover the best place for a
ihaft. An eight by 10 foot shaft is
: about a half a mile north of Camp
bay. It was 26 feet deep on September 14. The walls of the vein show very distinctly in the shaft, ranging from four to eight feet apart from the surface to the bottom. The quartz widens out from a few inches or a foot at the top to two feet at the bottom. In the shaft the vein matter consists of a hard schist on the foot wall, a soft schist on the hanging, and dark felsite and quartz between. The latter is heavily charged with pyrites. The quartz shows a large amount of free gold. Mr. A. B. Whitehead is general manager of the mine, and six miners are employed, all working in the shaft. The men were sleeping in tents at the time of my visit, but they intended to erect camps shortly.

A good wagon road leads from Camp bay to the mine. A dock has been built at the landing and steamers run from there to Rat Portage. Fifty tons of ore were to be taken to Rat Portage for a mill run, and there was already 20 tons at the landing.

On January 11 I got the following information from Mr. Wright, who is one of the owners of the mine and who had been out recently. The main shaft is 62 feet deep. At the bottom there is 15 feet of drifting along the vein in both directions. The vein is three and a half feet wide and contains plenty of visible gold. There have been built a sleeping camp, dining camp, powder house, stable and shaft house including blacksmith shop. A horse power hoist has just been sent out.

The Sultana Mine.

On June 30 I visited the Sultana mine, and also on September 23. During last summer very little work had been done below ground, as the entire milling and hoisting plant was being renewed. The old mill was kept running nevertheless, and sufficient work was going on in the mine, principally developing, to keep the mill supplied with ore. The following is the total extent of workings in the main shaft, to which all operations are now confined :

Main shaft of the Mine.

The shaft has been sunk to a total depth of 352 feet, and discontinued for the present as there is such a quantity of ore in sight that no more development work in a downward direction will be required

for some time. No. 1 level is 67 feet from the surface. No work has been done in it since last report. The north drift is 68 feet; the south 96 feet. In level No. 2, 127 feet down, the north drift has not been carried any farther; it is 67 feet. The south drift has been driven 160 feet. At a distance of 140 feet from the shaft a crosscut 12 feet wide has been driven west 30 feet. From the end of this crosscut the drift has been continued south 48 feet, making the total distance 200 feet from the shaft. In the third level, 187 feet from the surface, the north drift has not been carried any farther and is 13 feet. The south drift is 155 feet. At a height of 38 feet above the floor this drift has been continued south 34 feet, making it 189 feet altogether. In the fourth level, 262 feet down, the north drift is 52 feet and the south 94 feet. The fifth level is 337 feet from the surface. A drift has been run north 16 feet, and one south 40½ feet. A winze connects the first and second levels 35 feet north from the shaft, and another 80 feet south from the shaft. Between the second and third levels there are two winzes also, one 73 feet south from the shaft, and the other 142 feet south. Between the third and fourth levels there is a winze 102 feet south from the shaft. On the fourth level a winze has been commenced to connect with the fifth. It is 35 feet south from the shaft. On the third level, 35 feet south from the shaft, a winze has been sunk 26 feet. From the bottom of this winze a drift runs south to the winze connecting the third and fourth levels. Fifteen feet below the third level in this latter winze a drift runs south for a distance of 40 feet. A crosscut in this drift runs east 15 feet which is 165 from the shaft. The drifting between the levels has been done for the purpose of removing the ore body by underhand stoping. Fifteen feet of rock will be left for a roof in each case and the ore stoped out from this to the level below. The roof can thus be timbered and lagged at once, and there will be no further danger of falling pieces of rock. In the drift running north in the first level stoping has been carried 12 feet farther north than the end of the drift, with a raise of 40 feet all along. Fifteen feet of unworked ore is left at the shaft for security in al In the south drift stoping has been to the end with a raise of 35 feet. second level in the north drift stop been carried 24 feet north of the en drift with an average raise of 45 fe the south drift there is 20 feet of st feet from the shaft with a raise of 6 In the continuation of the drift south crosscut the ore has been stoped out a for a height of 30 feet. In the thi stoping in the south drift commences from the shaft, and is carried to the e a raise of 45 feet. No stoping has done in the other levels.

Old stoping and new.

On the fourth level near the sha sump 15 by 20 feet in size and 15 fee

There is a lot of old work on oth on the property, which has been m in the fifth Report of the

Old and new Workings.

An air shaft 32 feet east south drift in the first leve nected with the end of the latter by cut. At a distance of 400 feet north main vain is the Pasha vein, runnin E. It is three feet wide underne boarding house, where it has been un but appears to be much wider at th east end. Some shots have been p this end for prospecting purposes. T dips toward the main shaft, and it is can be worked from the latter by cross This vein is a new discovery and M well thinks that it may prove a valua

The Sultana has the largest body of sight of any of the mines in western

Ore body of the Mine.

As is well known, it is descr lens on account of its l shape. The main body lies on the s of the shaft; on the north side it i narrow. At the widest known plac is at the end of the south drift in t level, it is 66 feet; but a portion about 20 feet near the west wall, is l and will probably not be treated. is nearly solid quartz, only a little rock showing in places. At the en south drift in the second level it r 21 feet, and neither wall had been At the end of the south drift in th level it measured 32 feet, and only t ing wall is exposed. The vein is r

lling, there being only about one per
)f concentrates. Visible gold shows
e places, but it is not very common.
) of the new machinery was in opera-
the time of my last visit, but it was
expected to be placed in three or
four weeks from that date. In
use there is for drilling an air com-
, a receiver and one machine drill.
new mill a Rand duplex compressor,
)ndenser, having a capacity for twelve
3 being set up. Another receiver will
)d which will be kept in the mill, the
one being in the mine at the first level.
nore machine drills will be put into
)n. Buckets are still being used for
;, but two 2-ton skips are on the
)s, one of which will be used in the
haft down to the fifth level, and the
:ept in reserve. The skip-road and
way are being entirely renewed. The
iorse power hoister now in use will be
ted by a 75 horse power one made by
)f New York. The foundation is now
repared. The old hoister will be re-
or sinking below the fifth level. The
ister (which is not on the premises
o have two drums five feet in diam-
e for raising the skip in the main
id the other for a new shaft in con-
ion, which it is expected will be sunk
y on the main vein about 500 feet
the old one. A new rope one inch in
r, made of crucible steel, will be used.
s a 45 horse power boiler for the
and compressor now in use in the old
use. Self dumping cars will be used
iine and on the surface. Three or
l be used down below and two above,
the mill and the other to the rock
A large new shaft house has been
substantial timber work. Two tram-
e being constructed, one to the mill
over half completed, and one to the
np which is finished. The cars will
from a pocket into which the skip
np automatically. The pocket is
)d, with two outlets at the bottom.
will be stationed here continually to
a gate which is pivoted on the central
d which when thrown one way or the
charges the waste rock through one
opening and the ore through the other. The installation of the hoisting and the compressing plants is under the supervision of an expert at this work.

The machinery of the old mill, which was still running at the date of my last visit, consists of the following: A Blake crusher, two 5-stamp batteries, with Tulloch ore feeders, one Victory machine for catching float gold and amalgam, and two Frue vanners with 4-foot corrugated belts. There is also a small belt hoister for raising the ore from the shaft to the mill. The old mill will be closed down and removed entirely when the new one is in operation. A splendid new mill was being constructed, and was within three or four weeks of completion on my last visit. The building, which is 66 by 59 feet in size, is a fine looking structure. It has a substantially timbered frame-work, and the outside is covered, roof and all, with corrugated sheet iron and painted. All the latest machinery is being installed under the superintendence of a first-class Colorado mill man. The crusher floor is about 130 feet above the vanner room floor, and the latter is 20 feet above the lake level. The machinery consists of the following: A sizing screen, a Gates crusher, six 5-stamp batteries, six Challenge ore feeders, six mercury traps, six Frue vanners and a clean-up pan. The crusher is size 4, which has a capacity of 150 tons per 24 hours. The stamps, which are of the Fraser and Chalmers pattern, weigh 850 lb. each, will drop eight inches 92 times per minute, and the order will be the standard one, viz., 1, 5, 2, 4, 3. The bosses, shoes and dies are manganese steel, and the cams and tappets chrome steel. One new feature in this mill is that the stem guides are all independent, so that any one or more stamps can be removed without stopping the rest of the battery. The mercury traps are of the Victory machine type. They consist of half cylindrical troughs at the lower ends of the apron plates, into which the slime runs. A cylinder, the surface of which is amalgamated, revolves in the trough and being partially submerged catches all float gold and amalgam. The vanners have 6-foot corrugated belts. Power will be supplied by two 100 horse power and

The old Mill and the new.

one 75 horse power boilers (the latter one from the old mill) and a 110 horse power Corliss engine. The boilers are to be connected, and two used at a time while the third is being cleaned, thus preventing the necessity of shutting down. All the machinery is from the works of the Jenckes Machine Co. of Sherbrooke, Quebec, except the crusher, which is from the Gates Iron Works, Chicago. The batteries, crusher, boilers and engine were set up, and the machinery for the vanners, etc., on the premises at the time of my visit. There are two steel tanks in the mill, one with a capacity of 2,500 gallons to supply the batteries, and one for the boilers. The water is pumped from the lake, which is only a few yards away. Two pumps will be used, one for each tank.

The chlorination and roasting plants were completed in September, 1896, and run for a few weeks that fall. An account of the process is given in the last report of the Bureau, so that it is not necessary to repeat it here.

A saw mill for cutting cordwood has been built on the property by Mr. Kendal of Rat Portage, who has taken a contract to supply the mine with 2,500 cords. The old mill burns six cords per day, and the new one is not expected to burn more than eight.

There is a total force of 38 men employed, 12 of whom are miners.

The following buildings are on the property: Three private dwellings, three sleeping camps, boarding camp, two horse stables, cow stable, chlorination plant house, roasting plant house, filter press house, mill building, blacksmith shop, saw mill, general office, assay office, shaft house, ware house, dressing room, powder house, ice house, cook camp, store house, and pump house at the lake. There are also the old boarding camp, the old mill building, and blacksmith shop, all of which will be torn down. A small dynamo with a capacity of 56 lamps (incandescent) lights the mill and other buildings.

A small steamer, the "Sultana," with 33-foot keel and a four horse power engine belongs to the mine, and runs between there and Rat Portage and other points on the lake.

All shafts and open cuts are suitably fenced, and danger notices posted up. The main and air shafts are provided with guard rails at the surface. The sc... and ladder-way in the main sha... being renewed. In the ai... there is a suitable ladder-wa... ingress and egress. By means of th... shaft and the winzes, good ventilati... secured to the mine. The upper lev... provided with doors to prevent the c... from cutting across. For draining, th... a pump on the fourth level with a ... intake, and one on the fifth with a ... intake. A suitable dressing room is ... near the main shaft.

Condition of the Mine

I visited the Sultana mine on Febru... and make the following report on the m... progress of the same: No sinking ... been done since my former visit, ... the old hoist, with cable conn... with the bucket at the fifth level, is rea... the commencement of sinking, which wi... about a month hence. No work has ... done in the first or third levels since my ... visit. The stope in the second level ... has been driven 25 feet farther ... the end of the drift, with a rais... about 25 feet. Between the third ... fourth levels south the ore has all ... stoped out for a distance of 30 feet so... the winze connecting these levels. ... fourth and fifth levels have been conn... by a winze 35 feet south of the shaft. F... feet below the fourth level in this wi... drift has been run south 25 feet. The ... level has been driven north 35 feet, a... being continued. Ten feet north of ... shaft in this level a sump has been s... The new hoisting and air compressing p... are in operation, and the skip-road has ... constructed to the fifth level. The n... horse power double-drum hoister is in o... tion, and the inclined tramway has been ... to the mill.

Recent progress at the Sultana Mine

The old stamp mill has been removed ... the new 30-stamp one, with all concentr... machinery, etc., is in full operation. ... stamps first dropped on November 13.

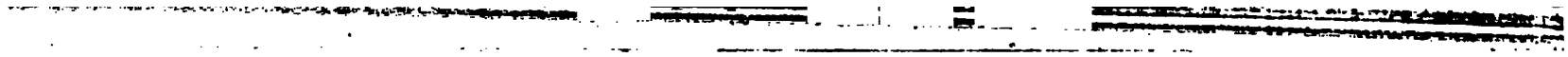
The mine is in a satisfactory cond... The skip-road is well constructed, and ... erly guarded at the levels and at the su... The ladder-way is in proper order, with t... ception that the cable used in sinking m... kept to one side so as not to interfere

No 1 shaft of Otisse Mine, near Schreiber, p. 80.

No. 2 shaft of Otisse Mine at Schreiber, p. 80.

Tunnel at Empress Mine, p. 80.

Mill of Empress Mine, p. 81.



travelling up and down. All the machinery in the mill is suitably fenced, but the hoister, the compressor and the engine require to be provided with guard rails.

Burley Mine.

Burley Mine in Bald Indian Bay.

A rather interesting piece of work is being carried on in Bald Indian bay, near the Sultana island. Water locations adjoining the island have been taken up by The Burley Gold Mining Company of Ottawa, Limited, for the purpose of working what is believed to be a continuation of the famous Sultana vein, where it extends under water. I interviewed Mr. J. Burley Smith, manager and engineer of the works, on January 26 and got the following note from him:

The water at this point varies from 16 or 18 feet to 24 feet in depth during the year, and there is a depth of from 3½ to eight or nine feet of blue clay at the bottom. A crib 60 feet square and 24½ feet high, built of heavy timber, has been sunk to the bottom and a vertical shaft six by 12 feet in size will be sunk inside the crib. The latter was built on an island—two of which, the Queen Bee and Chien d'or, about half a mile from Sultana island, are owned by the company—and towed out by a steamer to where the shaft is to be sunk. It is being loaded with broken stone, of which 1,600 tons have already been put in, and 250 tons more will be required. The shaft will be sunk on the "long bore" system. Vertical holes will be sunk by diamond drill at each corner to a depth of about 120 feet, and about 20 or 22 other holes to a lesser depth over the area of the shaft. These will be filled with sand, which will be pumped out as required to a sufficient depth for a blast. The shaft will be lined with masonry to a depth of probably 20 feet below bed rock, depending upon the condition of the latter, and the mason work will extend up to the surface of the crib.

All the machinery is on the property ready for putting in place as soon as the work on the crib is sufficiently advanced. The machinery consists of an Ingersoll steam hoist, a hoisting cable, a three-drill air-compressor, three machine drills, a steam centrifugal pump with a capacity of 2,500 gallons per minute and an 85 horse power boiler. All this machinery will be accommodated on the crib. The ore will be raised in cages and dumped into barges alongside the crib, in which it will be taken to a mill, probably the Keewatin Reduction Works.

Work commenced about the end of August. Earlier in the season there was a force of about 50 men, including carpenters, etc., but the number is now reduced to 22 men. Camps have been built on the island belonging to the company. Mr. Smith has informed me that operations will cease on February 2, pending the decision of the courts regarding the title to the property.

Mines on Shoal Lake

Yum-Yum Mine.

On September 17 I visited the Yum-Yum mine. This property consists of location S94, containing 96 acres. It is owned by the Yum-Yum Gold Mining Company, Limited, of Ottawa. Mr. J. Burley Smith is manager of the mine. Gold was first discovered on this location in the summer of 1896, by a red man known as Indian Joe. He discovered what is now called vein No. 1, and found free gold on it. He sold the property to Dr. Edmison, of Rat Portage, who sold it again in November, 1896, to the Yum-Yum Gold Mining Company. Like nearly all locations in the Shoal Lake country, the landscape of the Yum-Yum presents a much wrinkled and broken-up appearance. The country rock is altered trap. The veins are peculiar in being for the most part very irregular, on the surface at least; large splashes showing in places without any distinct walls, strong veins with good walls outcropping in other places, and being entirely cut off by a mass of country rock, then outcropping again, and so on. A diamond drill has been working on the property all summer testing all the veins, and its results go to show that the veins become more regular with depth.

Veins explored on the Location.

There are seven veins altogether, besides a number of small stringers. Five of the veins, viz., No. 1, 2, 3, 4 and 5, are parallel and run northwest and southeast. The other two, viz., G and H, are also parallel, but run northeast and southwest. As a general thing they cannot be traced continuously, or with a continuous

outcropping for any great distance, but only outcrop here and there where they have been stripped or the ground is elevated. Mr. F. Hockley, book-keeper at the mine, kindly showed me over the location, wherever any work had been done, but I am largely indebted to Mr. Smith for the following notes on the veins: No. 1 vein is at the northeast end of the location. It can be traced over most of the Yum-Yum property, and on part of the Nankipoo, which adjoins to the north. It varies in width from 18 inches to five feet. The vein matter is quartz and felsite, heavily mineralized and containing zinc-blende. A number of test pits have been sunk on this vein, and about 1,000 feet of stripping has been done. The vein branches in a couple of places. Vein No. 2 is next to No. 1. It can be traced across the location and varies in width from one to several feet. The vein matter is quartz. There is an open cut and a test pit 20 feet deep on the vein, besides several costeans. Vein No. 3, which is next to No. 2, is one of the best veins on the location. It can be traced for half a mile, and runs on the Nankipoo property. On the surface it varies in width from two to four or five feet. Where it cuts through a hill there is an open working 60 feet long and about 25 feet deep. This vein, like the others, has been tested by the diamond drill, and as a result a vertical shaft six by 12 feet in size is being sunk on the hanging wall side 33 feet from the vein. It was 31 feet deep on September 17. It was well timbered for a depth of 20 feet. The intention is to sink the shaft vertically for 120 feet, and then crosscut to the vein, working by 20-fathom stopes. The vein has been stripped and test-pitted at other points. No. 4 vein is not considered of much importance. It is only from one to two feet in width, and cannot be traced very far. But the assay goes from $17 to $18, which is higher than the general run. The vein matter is quartz, with a little country rock in places, well mineralized. There is a test pit and two costeans on it. I did not see much of No. 5 vein; it is said to be traceable on the Ontario Limited Property to the northwest. G and H veins are near the northwest end of the location. They can only be traced for a short distance. G vein, which is the more northerly, is exposed for about 20 or 30 feet near the shore on Bag bay. It then appears to dip under the trap, and outcrops again a short distance away. An open cut has been made upon it 40 feet long and about eight feet deep. There is also a test pit north of the open cut. The H vein has been stripped for 500 feet. There is another vein crossing this one at one point, and a large indefinite splash of quartz shows there. A little open cutting has been done at this place.

Mr. Smith gave me the following notes on the work of the diamond drill: On No. 1 vein No. 1 bore, made at an angle of 45° with the horizontal, crossed the lode where it was six feet wide. No. 2 bore, angle of 65°, crossed a lode two feet wide at a vertical depth of 112 feet. In the succeeding records the widths of lodes mentioned hereafter are the actual widths as calculated from the angle of the bore and the amount of quartz passed through, and the depths are the vertical depths. At a depth of 190 feet the same bore crossed a lode one foot wide, and at a depth of 214 feet crossed a lode nine inches wide. On No. 3 vein a bore at an angle of 43° at a depth of 88 feet crossed a lode 6½ feet wide. A bore at an angle of 62° crossed the lode 3½ feet wide at a depth of 165 feet. On No. 4 vein a bore at an angle of 70° crossed a lode 22 inches wide at a depth of 87 feet. No. 2 bore, angle 45°, did not strike the lode, but found a line of demarcation, which showed the existence of walls. On lode G the drill was stationed at different points. On No. 1 section, No. 1 bore, angle 53°, passed through a lode three feet wide at a depth of 25 feet. No. 2 bore, angle 71°, crossed a lode 15 feet wide at a depth of 30 feet No. 3 bore (vertical) cut the lode 8½ feet wide at a depth of 45 feet. On No. 2 section (new position of drill), No. 1 bore, angle 60°, at a depth of 72 feet cut the lode 2½ feet wide. Between G and H veins there is a wide valley with steep bluffs on either side, and Mr. Smith believes that down below there is a large lode, the walls of which correspond to the bluffs. A bore is being put down at an angle of 40° to crosscut this supposed lode, and also to cut the H vein. It was in 120 feet, measured along the bore on September 17.

Diamond Drill exploration.

When the shaft on No. 3 vein has been sunk 120 feet it is the intention to construct a wire cable way from the shaft to the lake, a distance of 1,223 feet, and to convey the ore to barges in which it will be carried to the Keewatin Reduction Works. A horse whim is to be put at the shaft soon for hoisting.

Good wagon roads have been constructed to different points on the location. A dock with 40 feet frontage has been built on the southern shore of the location, and it is intended to construct another in Bag bay near G vein.

There is a force of 14 miners at work, four of whom are diamond drill men.

The buildings consist of the following: Powder magazine, ice house, blacksmith shop, sleeping camp with accommodation for thirty men, dining camp, cook house, stores, assay office, office and manager's dwelling.

Recent operations.

The management of the mine has been recently transferred to Mr. R. H. Flaherty, formerly engineer at the Foley. I met Mr. Flaherty in Rat Portage on January 4 and got the following information from him as to the progress of work at the mine: The diamond drill has ceased work. The shaft on No. 3 vein has been sunk 86 feet and is being continued. It is believed that they are quite near the vein, as the selvage appears to have been struck. There is a force of ten miners, working one shift only.

The Mikado Mine.

Reports on the Mikado mine are contained in previous reports of the Bureau of Mines. I visited the place on June 28 and on September 16, and made the following notes on the extent of the workings and machinery, etc., on the property:

Workings in the main Shaft.

The main shaft, which is six by 12 feet in size, has been sunk 124 feet. Sixty feet from the surface a crosscut has been driven west 38 feet. From the end of the crosscut a level has been driven north along the vein 170 feet, and one south 175 feet. One hundred and twenty feet from the surface a crosscut has been driven west 56 feet, cutting the vein 24 feet from the shaft. In this crosscut a level has been driven along the vein north 154½ feet and one south 96 feet. Near the crosscut on No. 1 level the ore has been stoped out overhead for a length of 25 feet, and with an average raise of seven feet from the roof of the level. A raise 18 feet from the floor has been made near the crosscut in the stope. The vein shows an average thickness of about four feet in the mine. Mr. Doidge, the assistant manager, intends to do all stoping overhead. The ore will be stoped out all along for a height of about seven feet above the roof of the level, and a staging then constructed. All ore after this will be piled upon the staging and let down through chutes to the cars in the level below as required.

Other workings at the Mine.

An open cut 150 feet long, 20 feet deep and from five to 10 feet wide, has been made on the surface of No. 1 vein. On No. 2 vein an incline five by eight feet outside the timber has been sunk to a depth of 85 feet. This incline was full of water at the time of my last visit, as they were waiting for a pump. Mr. Breidenbach however told me that the vein, which was only two inches wide at the surface and assayed $200 per ton, kept this size and value for a depth of 50 feet, and at that point began to widen until at a depth of 85 feet it was six feet wide and the assay value decreased almost in proportion. But still it assays high enough to make a good paying lode. On the surface of No. 2 vein an open cut has been made 65 feet long, about 12 feet deep and four or five feet in width. A little stripping has been done on the vein north of the incline, and about 100 feet northwest of the latter a test pit has been sunk 25 feet. This vein can only be traced 70 or 80 feet, apparently. Six men have been prospecting the locations since August 1, and a number of small veins have been found, but not enough work has been done on any of them to be able to judge fairly of their value. One of the recent finds, known as No. 3 vein, is now being tested. This vein is on 147D. It is from two to eight inches in width, runs nearly east and west, and can be traced about 300 feet. A test pit is being sunk upon it, which was eight feet deep on September 16. A few shots have been put in at other places on the vein. It is nearly all capped over with earth,

etc., and has to be stripped in order to be exposed. The vein matter is coarsely crystallized blue quartz, slightly charged with copper pyrites. There is a few inches of trap containing more or less quartz alongside the vein.

Cost of Sinking and Drifting.

Sinking and drifting are done by contract. Mr. Breidenbach gave me the following figures showing the cost of such work: A four by six foot drift through quartz costs $12 per foot; through trap and quartz mixed, $9 per foot. Sinking the five by eight foot incline on the vein costs $16 a foot. The main shaft, which is six by 12 feet and driven vertically through country rock, costs $30 a foot. This includes timbering and manway.

Hoisting and Tramming.

In the main shaft cages are used in hoisting. Two cages, made by the Ingersoll Rock Drill Co. of Montreal, run in adjoining divisions of the shaft. They are connected so that one going down balances the other going up, thus economizing power. A 30 horse power hoisting engine, made by M. Beatty & Son, Welland, operates the cages. In the incline or No. 2 shaft hoisting is done by windlass and bucket. Two buckets are in use. It is intended to have a hoister at this shaft right away. There is 830 feet of tramway on the surface, and 500 feet in the mine. A tramway 480 feet long has been constructed from No. 2 shaft to the mill. There is also an inclined tram road 250 feet long from the dock in Bag bay to the mill, and a horse power whim at the upper end for hauling the ore to the latter place from the barges when ore from other properties is to be treated. Eight self-dumping cars, made by Woodside Bros. of Port Arthur are in use.

Pumping and Ventilation.

A Northey force pump for draining the mine has been placed on the second level in the main shaft. Korting's aspirator pipes have been placed in all the levels in the main shaft for ventilation purposes. These are ordinary 2-inch diameter iron pipes which extend down the shaft and branch off into the crosscuts and levels. After a blast and the miners have come to the surface, a jet of steam, from a small nozzle which enters a short distance into the open mouth of the aspirator pipe at the surface, is turned on for a few minutes, and, creating a powerful suction, carries a large quantity of air down the pipe and into the ends of the drifts, driving all smoke and foul gases up the shaft. The jet is then turned off, and the pipes being heated a gentle but natural current flows in the opposite direction up the pipes, thus giving ventilation for a considerable time.

The Stamp Mill.

A mill building 50 by 60 feet in size has been erected. It has been in operation for some months. The milling machinery consists of a Gates crusher, four 5-stamp batteries, two mercury traps and a clean-up pan. No concentrators are used, as it is intended to treat the whole product of the mill by the bromo-cyanide process after amalgamation. With the exception of the traps, which are home made, the milling machinery is all from Fraser and Chalmers of Chicago. The crusher has a capacity of 60 tons per 12 hours. The stamps are 850 lb. in weight, and drop eight inches 90 times per minute. A travelling derrick has been placed above the stamps for conveying heavy pieces of machinery. For power purposes there are two 70 horse power boilers, and one 70 horse power engine for milling; and a 30 horse power boiler for the hoister; all from the Waterous Engine Co., Brantford. There is 250 feet of 4-inch suction pipe running from the lake to the mill for water supply. The pump in the mill is 22 feet above the lake level, and it pumps into a tank on the crusher floor. Fire hose is kept near the tank in case of fire.

Condition of the Mine.

The condition of the main shaft, including the man-way, is satisfactory. The latter is cased off from the hoisting compartment, and is provided with ladders and platforms suitably arranged. The surface of the shaft is properly guarded. No work was going on at No. 2 shaft at the time of my visit. There is no dressing room at the main shaft and it will be necessary to construct one; instructions were given to this effect. Copies of the Mines Act were left with Mr Theodore Breidenbach, general manager of the mine, and with Mr. Alfred Doidge, assistant manager.

On June 28 there was a total force of 75 men, 46 of whom were in the mine. On

September 16 the force was about the same. Fifteen wood choppers were employed to supply cordwood for the mine. A number of wagon roads have been cut through the property for hauling the wood.

The buildings consist of the following: Assay office, general office, manager's dwelling, cooking camp, two sleeping camps, extra dwelling house, hoisting engine house, two shaft houses, boiler house, mill building, powder house, ice house, stable and blacksmith shop.

A viaduct 20 feet above the ground and 50 feet long connects the main shaft house with the mill. The cars can thus be taken from the levels in the mine to the crusher in the mill.

The steamer "Mikado," belonging to the company, runs from Rat Portage to the landing in Bag bay, where a good dock has been constructed. The mine can be reached more quickly from Rat Portage via Helldiver bay, whence a good road a mile long runs to the mine.

Meeting Mr. Breidenbach in Rat Portage on January 7, I got from him the following notes on the progress of work at the mine: In the main shaft most of the energy has been confined to stoping until lately, when sinking has been commenced again. No. 2 shaft has been sunk a vertical depth of 105 feet and drifting commenced at the bottom. The vein is six feet wide there, shows free gold and assays $10 per ton. One curious feature is that the visible gold in No. 2 shaft is in nuggets, while in No. 1 it occurs as leaf gold. On No. 3 vein the shaft has been sunk 45 feet and is being continued. It has enlarged from several inches at the top to five feet at the bottom, and the assays run from $1 at the surface to $7 at the bottom, increasing gradually. On 149D a shaft is being sunk on a vein showing 18 inches of quartz. This is parallel to the main vein. The shaft is 40 feet deep and is being continued. The assays are poor. An air compressor with a capacity of six drills has been installed, and three drills are employed in each shaft, i.e., No. 1 and 2. A 12 horse power hoister with iron buckets has also been placed at No. 2 shaft.

Recent progress at the Mine.

I visited on September 17 the Gold Coin and Monarch mines in Helldiver bay, but found no work going on at either of these properties.

Gold Coin and Monarch Mines.

Ontario Limited.

On September 18 I went over to the Ontario Limited property, which is situated on the southern extremity of the long arm running south from Bag bay. It is owned by the Ontario Limited Gold Mining Company of London, England, and consists of locations S74 and D203 and 204, aggregating 111 acres. Col. W. T. Engledue is president of the company, and his son C. W. Engledue is manager of the mine. Gold was first found on this property by a man named Israel Gagne in 1896. Clinton Markell of Duluth bought the property, and sold it to the present company in April, 1897. Two prospectors had been employed prospecting the locations from June 10 to August 21 of the past year. Camps were built and work on the veins commenced on the last of August. The formation is trap and coarse grained diorite. There are thirteen veins altogether, twelve of which are parallel and run northwest and southeast. Mr. C. W. Engledue showed me over the property, and with his assistance I made the following notes:

Ontario Limited property.

No 1 vein, which is farthest north, is on S87. It can be traced 900 feet, and ranges in width from three to seven feet, averaging about 4½ feet. The vein matter is quartz and felsite, chlorite schist occuring also in place. The quartz is well charged with pyrites. The vein has been stripped in several places, and three test pits sunk upon it, one at the south end five feet deep, and two near the north end, one of them eight feet deep. No. 2 vein, on the same location, but farther south, can be traced 420 feet. It is from two to six feet in width. The vein matter is mostly quartz, but felsite occurs also. A little stripping has been done on this vein. No. 3 vein, which is mostly on D204, has been traced about 350 feet, but is only about 12 inches wide. No. 4 vein appears to be a felsite dike. It has been traced for 500 feet, and shows a width in one place where uncovered of 12 to 14 feet. A test pit has

Mineral bearing Veins on the Locations.

been sunk on it to the depth of nine feet, and fifty tons of ore taken for a mill run. Farther north a little stripping and costeaning has been done. Veins No. 6, 7 and 8 all join at one point apparently, and No. 6 only continues past the junction. These are on location D204, near the centre. No. 8 is merely a stringer eight or ten inches wide, and has not been traced except for a short distance at the junction. No. 7 has been traced about 200 feet, and varies in width from two to four feet. It is nearly all quartz. Several test pits have been sunk a few feet upon it. No. 6 vein has been traced about 100 feet, and is a little wider than No. 7. A test pit has been sunk at the junction to a depth of 25 feet, and north of the pit an open cut has been made on the vein (No. 6) about 50 feet long and four or five feet deep. Fifty tons of ore were taken from this latter pit also for a mill run. No. 5 vein is traceable for about 100 feet and is from one and a half to three feet in width. It has been stripped in two or three places and a few shots put in. On No. 9 vein two test pits have been sunk four and seven feet deep respectively, and 15 feet apart. The vein shows a width of two feet, but has not been traced beyond these pits. No. 10 vein is not of much importance. It has been traced only 40 or 50 feet. Vein No. 11, which is on the southern part of D203, is 17 feet wide. It has been traced 220 feet. Five test pits several feet deep have been sunk upon it. The vein matter is quartz, felsite and schist, and contains a large amount of pyrites. No. 12 vein is close to No. 11, to the south. It is traceable for the same distance, and is five feet wide. The vein matter is probably of the same nature. It consists of quartz and green schist. Two test pits have been sunk upon it. There is a small quartz vein which runs up the face of a steep bluff on D204, and on to the Yum-Yum property, but no work has been done upon it. From the presence of felsite in a number of these veins, it appears that they are of a dike origin. On page 118 of the 1896 Report of the Bureau Dr. Coleman states that felsite dikes are frequently found in the Huronian rocks near the contacts with the granite, and that the quartz which they often contain is an after deposit filling in the fissures that are pro caused by the cooling and contracting o felsite, or by the subsequent shearing the old fracture.

Veins No. 4 and 6 are considered th on the property, and, as stated before tons of ore have been taken from each mill run. Whichever turns out the r will be sunk upon and developed.

There are seven miners at work, incl two who are still prospecting the prope

The buildings consist of a boarding a blacksmith shop and a stable.

Cornucopia Mine.

Cornucopia Mine.

On September 20 I visited the Corn mine on Cedar island in Bag bay. mine has been shut down all mer owing to trouble betwee owners, but I have learned that the di ties have been adjusted and that oper have commenced again.

Alexander M. Hay of the Dominion Mining and Reduction Company inf me that the property has been purchas the Cedar Island Gold Mining Comps Ontario, Limited, and Mr. Hay is act manager of the property at present. T bodies consist of a fair sized vein and a ber of stringers. A vertical shaft had sunk 75 feet by the former owners, M Kendall and Whiting of Rat Portage the present company, who commenced tions on December 20, 1897, have been ing and crosscutting since. There is foot crosscut at the bottom, and drifts been run east and west 10 feet and 1 respectively. The main vein has not struck at the bottom yet, and they are ing along a stringer for the purpose of ing this body. There is a steam hoiste a bucket for hoisting. The buildings c of a boarding camp, blacksmith shop, e house, shaft house, ware house, barr dry dock.

Cameron Island Mine.

Cameron Island Mine.

In the central part of Shoal lake the small island known as Cameron island, northwest shore of Stevens i This has been the scene of n activity for the past few months, and acc

to late reports bids fair to be a working mine in a reasonable time. The island is mining location S170, containing about 10 acres. Mr. J. J. Foster of Toronto owns the property, and Mr. W. M. Caldwell of Rat Portage is manager. It was discovered by Ralph McInkster and W. J. Cameron, of Rat Portage, and sold to Mr. Foster. Work commenced on July 29, 1897; before this only a little stripping had been done. I visited the place on September 20, and, going over the island with Mr. Caldwell, made the following notes :

The country rock on the island is green trap, quite coarse grained in some places.

Formation, Veinage and Works.

The rock is covered over with a thick capping of earth, roots, etc., and there is a growth of thick brush and small trees, which on the whole is difficult to remove and makes the work of stripping a slow and laborious process. Four veins have been discovered so far. The first three are parallel and have a strike of about N. 30° E. No. 1 vein, which is farthest east, has been traced about 150 feet. The average width is two feet, and the dip nearly 45°. The vein matter, which was much decomposed on the surface, appeared to consist of green schist or felsite and quartz. About 20 feet of open cutting to a depth of four or five feet has been done near the water's edge, and farther south a test pit and some stripping. No 2 vein is 20 feet west of No. 1. It has been traced 586 feet, being exposed only on both sides of the island. The average width is 2½ feet. The vein matter is the same as No. 1. About 30 feet of open cutting has been done at the north end, and a little stripping at the south end. Eighteen tons of ore were taken from these two veins for a mill run, and it ran $18.60 per ton. The main vein is No. 3. It is 100 feet west of No. 2. What appears to be the outcropping of this vein occurs at both sides of the island, a distance of 700 feet, and near the centre also. This ore body is a felsite dike. Both walls are uncovered at the north end only, where it shows a width of 16 feet. A six by 10 foot shaft is being sunk near the centre of the island, and a depth of 17½ feet was reached on September 20. The shaft is sunk on the foot wall, the hanging wall not being reached. At the bottom of the shaft, where decomposition has not gone far, the vein matter is quartz and felsite, with a horse of country rock in the centre. The amount of quartz is increasing with depth. There is a very large per cent. of pyrites all through the vein matter. About 12 feet of the dike has been stripped at the south end. The covering is four or five feet of earth and gravel. Near the west side of the island is a small vein of quartz six inches wide. This is No. 4. It carries galena, copper and iron pyrites and free gold. It has been traced about 100 feet, and has a strike of nearly east and west. A test pit has been sunk to the depth of 10 feet.

Just as I was leaving the men were stripping an outcropping of quartz and felsite on the northwest part of the island. The exposure was made by a tree blowing down and carrying the earth away in its roots.

The force consists of six miners at present. The buildings comprise a blacksmith shop, a powder house and a boarding camp, which have just been built.

The Engledue Concession.

Exploration on the Western Peninsula.

On September 25 I visited block B of the Engledue concession, which comprises 15,000 acres in that part of the Western Peninsula lying south of Carl bay in Shoal lake. This is being prospected by the Ontario Gold Concessions Limited, of London, England, and Mr. T. R. Deacon, O.L.S., of Rat Portage is in charge of the work. A small portion of the northern part of this property had been surveyed into mining locations after it had been conceded to the English company, and before the surveyors were notified by the Department not to survey upon it. This was nevertheless retained as part of the concession, and the remainder of the 15,000 acres has been surveyed by Mr. Deacon into lots in order to facilitate prospecting and make it more systematic. Lines were run east and west across the property one mile apart, dividing it into ranges. These ranges were subdivided by lines running north and south 20 chains apart, thus dividing the hitherto unsurveyed part of the concession into lots one mile long and a quarter of a mile wide.

[illegible] employed and [illegible]. The [illegible] were started so that each [illegible] with regard to the [illegible] of the [illegible]. The men were set [illegible] at a time, a number of [illegible] men. [illegible] backward and [illegible] way as the vein until [illegible]. The [illegible] the manager might [illegible] work at any [illegible]. The men were paid by the day, [illegible] a bonus of $50 was given to anybody that found a vein [illegible]. If the vein assayed $200 the [illegible] for assays ranging [illegible] was in proportion.

The country is almost entirely covered by muskeg and moss, making prospecting very difficult. The formation is trap, felsite and greenstone, the contacts not yet having been [illegible]. So far a number of the locations [illegible] have been explored. Of the [illegible] following is the list: Lots on range B, 13 to 20 inclusive; on range C, lots 7 to 12 inclusive; on range D, lots 13 to 18 inclusive; on range E, the same, and on F lots 20, 21 and 24.

I went over a portion of the property with Mr. W. F. Laing, who is foreman of the work, and examined some of the discoveries. At one point there is a vein of quartz containing a little country rock seven or eight feet wide, which can be traced 300 feet. Two test pits have been sunk upon it about 200 feet apart; one is eight feet deep and the other four or five feet. The vein is mostly covered over with earth, etc., but shows a good deal of quartz where it is exposed. About half a mile west of Dead Man portage, a reef of quartz and granite crosses a small peninsula which runs into Carl bay. It consists of a number of stringers in some places, and at others forms a solid mass of quartz. The walls are indefinite, but it is from eight to 20 feet wide, and about 250 feet long. A little stripping and blasting has been done at one end where a considerable amount of quartz shows. On lot 24, range E, there is an exposure of decomposed trap. It has no definite walls, nor can it be traced any distance. A test pit is being sunk upon it, but will likely be discontinued as there is not much of a showing. Close to the former there is a vein running east and west which has been traced 300 feet. A test pit is being sunk upon it, and it shows a width of four or four and a half feet at the point. The vein matter is blue quartz, hornblende schist and trap, all well charged with pyrites, and decomposed a little at the surface. There is about 12 to 18 inches of quartz. This appears to be a better vein than usual, and sinking will be continued for some time yet. There are some other leads on the property of more or less importance that I did not see, but none of them have been tested yet. Very little assaying has been done so far, and no very good results have been obtained from the assaying that has been done.

Progress of work during January.

I saw Mr. Laing in Rat Portage on January 5 and was told by him that a shaft had been sunk 30 feet on one location, and was being continued. On another location a shaft was being sunk and had reached the same depth. A diamond drill procured for the purpose has been started on this latter location.

Other Properties.

I left the Engledue Concession on September 21 on my way to Rat Portage. Stopping at a large island east of the Western Peninsula I saw what appeared to have been a camping place recently, and going inland found that considerable work had been done on a large vein running northeast and southwest. Two test pits had been sunk about 200 feet apart. One was 10 by 10 feet square and eight or nine feet deep. About eight feet of quartz showed, with distinct walls. The other pit was smaller and about eight feet deep. Felsite was the chief constituent of the vein in this pit. The country rock was green schist.

Island locations east of the Western Peninsula.

Paddling along the north end of Shammis island, we came to a place where the outcropping of a large felsite dike was exposed on the shore. Some blasting had

been done here, and going inland I found a pit on the same dike about 100 feet from the shore. The dike was mostly quartz at this point. The pit was only six feet deep.

Mines near Rat Portage

The Triumph mine, an account of which appears in the last Report of the Bureau of Mines, and which had lain idle for about a year, is again in operation. Mr. C. S. Morris was the original owner of this property. Messrs. E. W. Barnes and A. B. Upton bought it from Mr. Morris, and in September, 1897, they sold it to the Triumph Gold Mining Company, with head office at Alpena, Michigan. The recommencement of work dates from July 1. Mr. J. S. Rayburn is superintendent and Mr. Charles Brent, M. E., of Rat Portage is engineer. I got the following notes from Mr. Rayburn in January:

Triumph Mine.

There are about 30 veins on the property. Five test pits, 10 feet each, have been sunk on the different veins. A shaft is being sunk which is now 113 feet deep, and a contract has just been let to sink it to 200 feet. No drifting has yet been done, nor will there be until this last contract is completed; then it is likely that 100-foot and 200-foot levels will be established. There is an old Tremaine steam 2-stamp mill, which was put up by former owners, but is now lying idle. A new hoist is just being set up. The buildings consist of a new shaft house, ore house, boiler house, mill building, blacksmith shop, dressing room, office, boarding house to accommodate 25 men, and a barn. There is a force of 10 men, including seven or eight miners.

On September 25 I hired a saddle horse and made a trip into the country for the purpose of examining the Scramble and other mines in that vicinity. There are quite a number of properties which have been worked more or less in Jaffray and Haycock townships near the Scramble. I visited the later place first. It is situated about four miles from Rat Portage, east. As neither Mr. Halstead nor Mr. Partridge was present at the time, but were expected later on in the day, I went about three miles further to what is called the Black Sturgeon mine, intending to return to the Scramble later.

Properties in Jaffray and Haycock townships.

Black Sturgeon Mine.

The Black Sturgeon comprises lots 11 and 12 in Jaffray township. Andrew Benson is owner and manager. The discoveries were made by Mr. Benson in 1896. The country rock is granite and slate, and a little trap occurs also. Considerable prospecting has been done and quite a number of veins have been found. No. 1 vein, on lot 11, is believed to be a contact between the granite and schist, and has a strike of northeast and southwest. Two shafts have been sunk upon it about 1,200 feet apart. No. 1 shaft is 42 feet deep. The vein is covered at this point with 38 feet of loose material, clay, boulders, etc., and as it does not outcrop near by the position of the shaft was got by calculation. It was intended to be directly on the vein, but unfortunately it struck the latter just to one side. The shaft was enlarged to the width of the vein and sinking continued. A considerable amount of water was coming into the shaft, and operations were suspended at the time while waiting for a pump. The shaft was well timbered to the bed rock and a new shaft house had been built over it. No. 2 shaft, which is northeast of No. 1, is seven by nine feet in size and 36 feet deep. It was sunk last winter by a Winnipeg company which had an option on the property, but Mr. Benson has since bought the option back. Nothing was being done in this shaft.

Black Sturgeon Mine.

Besides these shafts there are on lot 12 four or five test pits on different veins, ranging from four to 10 feet in depth. The shaft and test pits were not fenced, and I called the manager's attention to the necessity of so doing. He has informed me since that he had fenced them as requested. There are six miners employed on the property, but the work that is being done is only prospecting. Good buildings have been constructed, and consist of two shaft houses, boarding camp, blacksmith shop, dwelling house and dressing room.

Princess Mine

The Princess mine is also in this section, and is about two miles from the Scramble.

The Princess Mine.

The nearest railway station is Rossland, which is three miles from the mine—one and three-quarter miles by water, and one and a quarter by land. The property is owned by the Princess Gold Mining Company of Ontario, Limited. Work commenced here about the first of May and three or four men have been employed all summer. The formation is similar to that of the Black Sturgeon. There are a number of small outcroppings on the property, but likely only a few veins. The main vein shows on the top of a hill about 100 feet high. There is a small outcropping of white quartz which showed free gold plentifully, and a shaft has been sunk upon it. It is four by eight feet inside the timber and 65 feet deep. The quartz disappeared about 15 feet from the surface and Mr. Collins, the manager, thinks that it is on the foot wall of the shaft. Crosscutting to the south or foot wall side has commenced in the bottom for the purpose of striking it again. Felsite was struck shortly after losing the quartz, and there is about five feet of it in the bottom of the shaft, which carries a certain amount of gold. About 50 or 60 feet north of the shaft is a felsite dike, containing a little quartz, about two feet wide, which has been traced a few hundred yards with a strike of northeast and southwest. It is expected that this dike, which is dipping towards the main shaft, will join the latter farther down or else be worked from it by a short crosscut. A couple of small test pits have been sunk at other places on the property. The buildings consist of a cooking camp, a sleeping camp and an office. There were two miners at work during my visit, and Mr. John Collins was manager.

Scramble Mine.

Having finished with the Princess, I returned to the Scramble, descriptions of which have

The Scramble Mine.

been given in the fifth and sixth Reports of the Bureau. I went over the property and looked at most of the veins, of which there are eight altogether. The main vein has a strike of northeast and southwest and can be traced 650 yard according to report much farther on a ing properties. The vein appears to two parts at the surface ; there is a stringer a foot wide showing at one pla 15 feet from this the band of mica or fahlband, as Dr. Coleman describes feet wide ; but it is likely to be all th vein, as the only distinction is that t feet between does not carry any gold to of at the surface. The vein maintai width right along, but the quartz st itself is only traceable for 150 yards. 70 or 80 yards southeast is a small vein two feet wide. It only shows i place, where a small test pit several fee has been sunk. Much free gold was in this vein. A few hundred yards sou of No. 1 vein is a parallel quartz vein has been traced and stripped for 20 fee is from 18 to 30 inches wide. This wa covered last June. It does not carry pyrites, but shows gold on panning. 40 feet north of this is another paralle from four to five feet wide, which has traced 150 or 200 yards. Stripping an pitting have been done in several along it. There are also several small q veins a few inches wide running in dif directions close to these veins. A few dred yards south of the main shaft a te has been sunk 11 feet, in a place wher veins intersect. They do not outcro place else, but it was concluded from t with the "mineral rod" that one runs main shaft and the other is parallel t main vein. Another ore body which not see is described as a large felsite di the north side of the property, and whic not considered of much importance a time.

Two shafts have been sunk on the vein. The main shaft, which is eight feet inside the timber, is 85 deep. Fifty feet from the su is the first level. A fork has driven 14 feet into the foot wall, and the hanging wall a crosscut has been d northwest 57 feet. From the end of crosscut to the fork is a distance of 79 which appears to be all vein matter, as can be found by panning in different

Shafts on the main Vein.

in the crosscut. It is uncertain just what the width of the pay ore is, but there is about 30 feet of it at least and probably much more. In a recent interview Mr. Halstead told me that an expert had been examining the mine lately and got an unexpectedly high average assay in the crosscut. Near the shaft there is about 12 feet of the vein which carries more quartz than usual, and is richer than the rest also. It is all well charged with copper and iron pyrites. About 200 feet from the main shaft on the same vein is No. 2 shaft. This has been sunk 52 feet and discontinued. Seven or eight hundred feet farther on an open crosscut has been made through the earth down to bed rock, but this is now partially filled again. Considerable stripping has also been done on the vein. There is a large seepage of water in the main shaft, and a Northey pump with a capacity of 65 gallons per minute has been placed 72 feet down for drainage.

The hoisting machinery consists of a 12 horse power hoister made by the A. R. Williams Machine Company of Toronto, and a 14 horse power upright tubular boiler. Two tanks are used for water supply, the water from the shaft being used. It is pumped into a 34-barrel tank outside and allowed to settle. It is run from there into an 8-barrel tank in the engine house.

Condition of the Mine.

The shaft is provided with a suitable manway to the first level, with ladders and platforms as required by the Mines Act. The surface is provided with a suitable guard rail. The bucket way at the first level is not fenced at the north side, and a temporary guard rail must be placed there that can be removed when necessary. No work was going on in the main shaft when I was there, as the miners were waiting for the pump to be fixed. There was a force of five miners, but more would be required when operations started again. Fine, neat and roomy buildings have been constructed. They consist of sleeping camp, dining camp, two dwelling houses, store, dressing room, stables, driving shed, ice house, powder house, shaft and hoist house and blacksmith shop.

I met Mr. Halstead on January 5 and got from him the following information : Seventy-five feet from the surface in the main shaft a drift has been run northeast 21 feet. Nothing else has been done in the mine, and work has been discontinued for the present for a short time. The main vein has been stripped 116 feet more, close to the main shaft, and free gold was found all along. A test pit has been sunk also. Five hundred feet south of the main vein a quartz vein has been stripped 300 feet. It was six feet wide and carried free gold.

Recent Workings at the Mine.

Gray Eagle Mine.

About four miles east of Rat Portage, south of the railway track, is a property called the Gray Eagle mine, which is owned and worked by the International Gold Mining and Development Company, with head office at Cleveland, Ohio. Mr. John Kennedy of Rat Portage is manager of the mine. The country rock is green schist and trap. The ore bodies are large felsite dikes which contain a few stringers of quartz. There are two or three of these dikes on which some work has been done. The main dike is traceable for several hundred feet and is 17 feet wide at the shaft. The strike is northeast and southwest. A six by 12-foot shaft is being sunk which was 32 feet deep on October 1, the day of my visit. Mr. Kennedy told me lately that it had been sunk to a depth of 50 feet, which fulfilled the contract, and work has discontinued for the winter as the company does not want to go to the expense of building camps at once. But it is stated that in the spring operations will be resumed and the shaft carried to a depth of 200 feet. The contract just finished was to sink from 30 to 50 feet at $22.50 per foot. It was simply the continuation of an old shaft. Mr. Alan Macdonald of Rat Portage is the contractor and had a force of seven men at work, including four miners. A few hundred feet southwest of the shaft there appears to be another dike joining the main one, but no work has been done upon it. About 100 yards northwest of the main dike is another of apparently the same size. A test pit had been sunk eight feet on it previous to the commencement of work by the present company.

Gray Eagle Mine.

Keewatin Reduction Works

One concern which has every promise of giving a good impetus to mining and developing when it is completed is the Keewatin Reduction Works, mentioned by Mr. Blue in the sixth report. These are situated in Keewatin, a small village three miles from Rat Portage, on the Lake of the Woods, and are owned by the Ottawa Gold Milling and Mining Company of Ottawa, Limited. The property consists of 25 acres.

Objects of the Company.

The company is formed solely for the purpose of doing custom work in the treatment of ore. and does not intend to operate any mines of its own. It intends for one thing to furnish a means of enabling prospectors to have their ore milled as it is mined, thus allowing them to pay the cost of mining from the beginning and dispensing with the necessity of waiting for capital to develop their properties. This means the opening up of a great many properties which might otherwise remain idle for a long time. But the company also intends to aim at doing away with the necessity of miners erecting their own mills, by making arrangements to buy or treat all their ores. This latter will apply particularly to the Lake of the Woods country. One of the important features of the works is a first rate sampling apparatus by which all the ore brought there can be sampled with absolute fairness, and then assayed and the value given to the owner before any milling is done. The cost of treatment of the ore will be approximately proportional to the assay value. Or the ore may be bought outright and the price paid for it the gold value minus the cost of treatment. Poor ores, which run under $3 or $4 to the ton, will be treated with no profit, or perhaps at a direct loss to the company; but indirectly there will be a gain, as it will encourage the development of mines and so increase the business, as in many cases the ore is poor at the surface but rich farther down.

Features of the Mill.

The works will consist of a sampler and crusher, a stamp mill with concentrating machinery, and later on a chlorination plant, so that any kind of gold ore can be treated. Steamers and barges to convey the ore from the mines also form an important feature. The machinery is be of the most improved class and of th quality. I visited the place on Septem and was shown over the property b Frederick T. Snyder, the superinte The work of building was then being on as fast as possible. It was expec have the sampler ready in a few week the mill in the spring. The sample storage building, which is 40 by 110 f size, was nearly completed. It is ver stantially built with heavily timbered work, well braced, and diagonal shea The mill building, the foundations and work of the timber of which was comp is to be of the same size and close by. chlorination plant had not been comm yet. The foundations of the standards cable-way were nearly completed also.

Transporting of Ore.

The ore will be transported from the in 30-ton barges, eight of which have built, and thirty or forty mo likely be constructed in the s From the barges it will be carried over foot cable-way to the works. As the situated on a branch of the Winnipeg and the railway comes between them a lake, the ore has to be carried over o cable-way. The cable is stationary. two-ton skips are in use at a time; one ling over while the others are being load emptied respectively. One skip will per minute. The skips will discharge W-bin of 60 tons capacity, above the cr

Milling and Sampling Plant.

The crusher, which is a Blake, crus sizes of one and a half to two inc diameter, and has a capacity tons per hour. In this crush outer jaw moves and has a parallel m The size of the opening is 12 by 20 i The crushed ore passes over a sizing sc one inch mesh, and the "fines" go t sampler. What passes over the scree to the rolls, and then over the scree the crusher product again, and so on. bit of the machinery has the latest fe in improvements that have been made. Cornish rolls, which are 36 inches in di by 10 inches across the face, have a c of 10 tons per hour. They crush to le an inch. They are the heaviest type o the whole machine weighing 26,000 lb

springs give a pressure of 8,000 pounds per inch, or 80,000 pounds on the whole roll. There is a feeder or distributing box which spreads the ore evenly along the rolls and prevents uneven wear. The sampler consists of a pan shaped like a gold pan, and revolving on a horizontal axis. In the splayed side there is a radial slit nearly the length of the side. The pan makes 30 revolutions per minute. The crushed ore or "fines" runs from a chute into the revolving pan and into a bin below. At each revolution the slit comes underneath and the stream goes through into another bin: this is the sample, which is dealt with separately. Now there are two different principles of sampling; one is to take a portion of the stream of ore all the time, and the other is to take all the stream a part of the time. This latter is recognized now by experts as being the more reliable principle, and it is the one which is involved in the above apparatus. The sample is thoroughly mixed and quartered, being gradually reduced to a workable quantity and then ground fine and mixed again. This is divided; one half given to the customer for a check and the other half assayed by the company.

Storage Bins.

The ore from the sampler is conveyed on an endless rubber belt 20 inches wide, running horizontally to large W-shaped storage bins which have a capacity of 2,000 tons, and provision is made for indefinite increase. The bins are divided into compartments, so that each quantity of ore can be kept separate. The W-shape, which means that there are two outlets at the bottom, enables any one bin to be utilized without the necessity of waiting until it is entirely emptied, by throwing the remaining ore into one side.

Extent and capacity of the Mill.

A 20-stamp mill will be erected at once, and provision made for increasing it to 60 stamps when business demands it. The stamps will weigh 950 lb., fall nine inches probably (depending upon experiment) and drop 90 times per minute. No amalgamation will be done in the battery, which will be double discharge. It is desired to get the greatest possible capacity, and the small size of the crushed ore will enhance this. At least five or six tons per stamp is expected per day. Experiments will be made with different materials for shoes and dies. Some are made of chilled iron, some of Wilson compressed steel, and others of chrome steel. The chilled iron will be used as a standard for experiment A battery of the latter will be placed alongside one of the Wilson compressed steel, and both batteries always run together on the same ore. The same plan will be carried out with the chilled iron and chrome steel. Whichever proves most satisfactory will be adopted thenceforth. The ore will be carried from the storage bins to the batteries on a rubber belt similar to the previous one mentioned, and connection will also be made with the sampler so that ore can be taken directly from the latter without going to the bins. Hanging Challenge feeders will be used.

Concentrating and Amalgamating.

The crushed product will run from the battery direct to the concentrators and then over the amalgam plates. Part of the free gold will thus be kept with the concentrates, but the tailings, freed from the latter, will give less trouble in amalgamation and a higher percentage of extraction will be obtained. The vanners will have 4-foot plain belts, and one novel feature about them will be the gyrating instead of lateral vibrating motion. This, Mr. Snider says, will largely increase their capacity and give an equally good concentration. The amalgam plates will also have this motion for the same reason. For each battery the plate will be eight feet wide and only six feet long. No mercury traps will be used, but the work of the amalgamators will be watched and checked closely.

All the milling and crushing machinery is from the Gates Iron Works of Chicago.

Driving power of the Works.

One thing that will tend to lower the rate at which ore can be milled is the cheap power at hand There is a fall of 16 feet here between the lake and river, and it is calculated that 1,200 horse power is available. There are three old turbines on the property which had been used formerly and are now being set up. They have a combined capacity of 500 horse power, although not more than 250 will be utilized even when the 60 stamps and other machinery are in operation

Mr. Snyder gave me the following table of charges, based on a three per cent. concentrate basis, which he had worked out :

	$	$	$
Assay value of ore..	10.00	20.00	30.00
Sampling	.85	1.10	1.35
Milling (including retreatment of concentrates)... ...	1.50	2.00	2.50

Assuming that 80 per cent. of the gold is saved, which is a fair assumption, this leaves on a $10 ore $4.62 for mining and transporting on barges, on a $20 ore $11.91, and on a $30 ore $19.11.

A good assaying laboratory has been built, and facilities will be had for buying bullion.

On January 14 I visited the works again and found the sampling and crushing department in working condition and the stamp mill completed. The buildings are covered with sheet iron. The sampling department is provided with scales for weighing all the ore after sampling and before going to the storage bins. The carrying belts were running, and performed their work very satisfactorily. In the mill there are four 5-stamp batteries as intended. One battery was in operation, and the rest are expected to be in a few days. The stamps fall between seven and eight inches and weigh 950 lb. One hundred drops per minute will be the rate. They are running with a capacity of four tons per stamp per 24 hours at present, and it is expected to get six tons per stamp ultimately. The ore does not go direct to the vanners from the batteries as first intended, but passes over gyrating amalgamation plates at the stamps first, then over the vanners, and the tailings to other gyrating amalgamation plates. Before the first amalgamation plates were used it was found that the vanners collected practically all the free gold with the concentrates ; hence the question was merely a commercial one of losing the interest on the gold for so many months, or until such time as the chlorination plant was erected and the concentrates treated. There are four Frue vanners and two gyrating ones. The latter are supported on upright flexible steel rods, one at each corner In the centre underneath is an unbalanced pulley, running on a vertical axis and attached to the vanners. This is driven by a belt coming from a shaft overhead, around pulleys attached to the sides of the vanner and around the unbalanced pulley in question, thus giving the whole vanner a horizontal circular or gyrating motion. The amount of this motion can be regulated by adding weights to one side of the unbalanced pulley. The mechanism is extremely simple and effective. The vanner is much lighter than the ordinary Frue, and should be cheaper also. The feeding of the belt is the simplest part of all. There is a friction clutch attachment to the roll at each corner by which the latter is turned a certain amount with every gyration. One of the machines was running, but no ore had been treated on it yet. All the vanners have 4-foot plain belts. The gyration of the amalgam plates is produced in the same way. There are eight of these plates, one in front of each battery, and one for the tailings of each.

Some modifications in the completed Works

There is about 350 tons of ore in the storage bins which has been crushed and sampled, and was being put through the mill at the time of my visit to the works.

Brent's Sampling Works.

Mr. Charles Brent of Rat Portage has fitted up a sampling and assaying laboratory in that town, and is prepared to deal with samples weighing up to two tons. The sampling machine consists of a No. 0 Gates crusher, crushing rolls and a steel sampling floor. A sample grinder has been ordered also. Power is furnished by an engine and a boiler of 12 horse power each. The assaying laboratory is well provided, the furnaces burning crude oil mixed with superheated steam. At present laboratory tests by chlorination and cyanide can be made on a small scale. Mr. Brent intends to erect a small stamp mill in the spring, with concentrating machine and chlorination and cyanide plants.

Brent's Testing Laboratory at Rat Portage.

Mines of the Upper Seine

The two mines which are making the Upper Seine river country famous are the Sawbill and the Hammond Gold Reef, both situat

on the eastern side of Sawbill lake. I visited these places three times in 1897—on July 16, October 14 and December 10.

The Sawbill Mine.

The Sawbill property consists of locations 313 and 314X. The mill sight is on 323X, adjoining the former and bordering on the lake, the surface rights of which have been leased to the company. The company which owns the mine is the Sawbill Lake Gold Mining Company, Limited.

Sawbill Lake Gold Mining Company.

The formation of the region is an altered granite, and some small bands of green schist occur in places. Several veins have been found. The main or Sawbill vein, which is on 313X, has been traced 2,000 feet with a strike of N. 25° E., and shows in the shaft a nearly uniform dip of 75° east. About 350 feet west of this is No. 2, or Sawbill Junior vein, which has been traced 1,000 feet. On the southeastern corner of 314X is a deposit which is similar to and is believed to be the continuation of the Hammond Reef, which will be mentioned later; there is about 1,000 feet of it on the location. There are several other veins on the property which I did not see, but which may prove to be important when more testing is done.

Description of the Company's Properties.

The Sawbill Junior vein has been stripped for 100 feet, and where it crosses the corner of 323X a test pit has been sunk 12 feet. On the Hammond Reef stripping has been done for a length of 150 feet, and also a little blasting in several places over the surface. Lately over 200 feet has been uncovered for the purpose of ascertaining its width, but the walls or boundaries were not reached. Several test pits have been sunk at different points along the main vein.

A shaft seven by 10 ft. inside the timber has been sunk on the main vein to the depth of 205 feet. Sixty feet from the surface a level has been driven south 195 feet, and one north 177 feet. At a distance of 186 feet south of the shaft on the same vein an air shaft has been sunk to connect with this level. At a depth of 120 feet in the main shaft a level has been driven south 117 feet and one north 135 feet. On this level a sump eight by 14 feet in size and 15 ft. deep has been sunk 15 feet south of the shaft, and a fork driven into the west wall of the drift. A No. 4 Blake pump is used. All stoping is overhand. In the first level south stoping is being carried on near the shaft; the stope is 40 feet long and has an average rise of 28 feet above the floor. Stoping has been commenced in the north drift also. So far the stoped out portion is about 25 feet long with an average raise of about 10 feet above the floor. In the second level south there is a stope near the shaft 40 feet long and 25 feet from the floor at the highest point, the average raise being about 18 feet. The vein is composed of a white milky quartz containing a little pyrites and galena. Free gold is quite common all through it. It has good walls and ranges from two to eight feet in width underground. the average being about four feet. I did not get down to the bottom of the shaft as there was 15 or 20 feet of water in it—operations having ceased while they were waiting for a pump—but Mr. Wiley told me that the vein had widened out to six feet there. Drilling so far is done by hand, but it is the intention to put in an air compressing plant soon.

Main shaft of the Mine.

Tramways are laid in all the levels and small trucks convey the buckets from the working faces to the shaft. A 15 horse power hoister, made by Miller Bros. & Sons, Montreal, and a 25 horse power boiler constitute the hoisting machinery. A $\frac{3}{4}$-inch steel wire rope is used. At the surface tramways are laid to the rock and to the ore dumps, and one 550 feet long runs to the mill. The loaded cars run down by gravity. Four self-dumping cars are employed altogether.

A stamp mill has been built and has been running since about the first of October, 1897. The machinery, which was made by Fraser and Chalmers, consists of a sizing screen, a Blake crusher, two 5-stamp batteries with Challenge ore feeders, a Brown's four-compartment hydraulic sizer, mercury traps and three Frue vanners. The battery room is 36 by 24 feet, the vanner room 40 by 24 feet, and the engine and boiler rooms each 34 by 23 feet in size. The stamps weigh 850 lb. and have a speed of 90 drops per minute. The shoes,

A ten-stamp Mill in Operation.

dies, cams and tappets are all forged steel. A 30-mesh sieve is now being used. Finer meshes were tried, but the gold in this ore is coarse and it is found that the tailings do not assay any higher with the 30-mesh while the capacity is increased. Two of the vanners have 6-foot plain belts, and one a 4-foot corrugated belt. Power is furnished by two 35 horse power boilers and a 70 horse power Corliss engine from the Waterous Engine Company.

Water supply for the Mill.

For water supply in summer a small creek has been dammed about 600 feet from the mill. A well 20 by 30 feet in size and 12 feet deep has been excavated behind the dam. A 3-inch pipe runs to the mill. The tank in the latter is 20 feet lower than the dam. This is expected to supply water for six months in the year, but for winter use a pipe 1,600 feet long had to be run from the lake and a pump stationed there.

Condition of the Mine.

A ladder way has been provided for ingress and egress in the main shaft, but it is not cased off from the bucket way, nor are the ladders properly arranged. But the manager intends to have a new hoisting plant installed soon, and instructions were therefore given to have the man-way secured according to the requirements of the Mines Act as soon as possible. It is expected that the air shaft will be continued to the second level, and it may be used as a manway. The skip-way is not fenced at the surface, nor at the levels, and this must also be attended to. Trap doors to the ladder and skip-ways are provided where necessary.

The mill machinery is all properly guarded, and railings were placed at the crusher and battery floors as directed. A dressing room has been built near the shaft.

Officers and Miners.

Mr. F. S. Wiley is general manager of the mine. Mr. G. H. Brotherton was superintendent at the time of my first visit, but Mr. S. B. Schrontz, who supervised the construction of the mill, was appointed to the position later on. Mr. C. C. Schrontz, son of the former superintendent, is now in charge. There is a total force of 50, of whom 25 are miners.

Buildings in connection with the Mine.

The following buildings are on the property in connection with the mine: Shaft house, engine house, dressing room, powder house, blacksmith shop, office, assay office, mill, saw mill, oil house, boarding cam; living houses, warehouse, s and pump house. A saw m longing to the mine, with a ca of five or six thousand feet per day, is ed on the lake and cuts all the timb lumber, building and mining purposes.

Good wagon roads have been consti where necessary on the property. The

Access to the Sawbill Region.

bill country is not so easy of as most other sections. The two ways of reaching it fro the railway. One is the canoe route Savanne, which takes two or three but most of the travelling is do the other, which is by way of Bo whence a stage runs every day in the mer and every second day in the winte the summer time the stage runs within miles of the mine to a place called Red from which point there is a water r the mine. The distance from Bonh Sawbill is 38 miles and can be mad day. There is talk of the Canadian Railway Company constructing a tra to facilitate travelling.

Hammond Gold Reef.

History of the Reef Mine.

Adjoining the Sawbill properties famous Hammond Gold Reef, which object of so much interest country both on account of mendous size and the peculia its ore. The discovery of this reef wa by an Indian named Kabaskong, who an outcropping on what is now 316 showed it to Mr. James Hammon present manager of the mine. Mr. mond and Henry Folger, who were pa took up locations 316 to 322 X, all of are on the reef except the last; 33 338X were taken up later on. In D ber, 1896, a half interest in 337 and was sold to the Hammond Gold Reef M Company, and operations commenced on January 1, 1897. But a lawsuit ha held over locations 316 to 322 X, ar result Messrs. Hammond and Folger tained only a two-thirds interest be them. Half of their interest in thes tions was then sold to the Folger-Ham

Camps of the Golden Star Mine in Summer of 1897, p. 73.

Camps of the Golden Star Mine in Winter of 1898, p. 73.

Shaft and Engine House of the Golden Star Mine, looking toward the hill, p. 73.

Golden Star Mine, showing 1,500-ton stock pile, p. 73

Reef Mines Company, and operations een commenced here also. There are wo companies working on the reef.

formation here like that of the Saw- altered granite. There are three ore bodies on 337 and 338X; two quartz veins and part of the reef.

An account of the latter will pro- be given in Dr. Coleman's report, as ited the place during the summer. it to say here that it consists of a e of altered granite, quartz and chlor- h streaks of green schist. It has been three or four miles, and has a general on of northeast and southwest. Strip- as been done in a number of places in to obtain its width. The boundaries ther indefinite, but as near as can be ined it is 462 feet wide at the widest place, which is on 317X. On the ns we are dealing with, viz., 337 and it varies in width from one to two ed feet. One hundred feet is its width narrowest place as far as known. It t yet been proven to what extent it is earing, but so far the results have been satisfactory. Its value can only be however by a number of mill runs from different parts of it. Several of have already been made and show an e of between $6 and $7 per ton. In the gold runs in pay streaks which been defined but to a very limited ex- It is probable that the greater part of ef will have to be milled, and that a stamp mill will be required to deal suc- lly with the proposition.

mining on the reef will be open work, the exception of the sinking of test shafts. A considerable amount of work has already been done. On 337X an open crosscut has been 300 feet long and 20 feet deep on the e. From the crosscut on the south large open drift has been made in the 7 feet long, 40 feet wide and 38 feet

There is a pay streak in the west f this drift about 16 feet wide. The g has been carried 24 feet farther south or an average width of about eight feet. e east side of the drift the ore has been ed out all along for a depth of from five to 10 feet below the floor, and for an average width of about eight feet. The ore which is being treated in the mill is all from this open drift. On 338X a test shaft has been sunk on the reef to the depth of 80 feet. Sixty feet from the surface a crosscut has been driven east 20 feet, and one west 17 feet. The ore at the bottom of this shaft differs considerably from that at the surface; there appears to be more chlorite and quartz in it. It assays $3 to $4 higher than at the surface also, and is the same all along the crosscut- tings. Where the reef crosses locations 316 and 317X to the south a considerable amount of test-pitting and open-cutting has been done; and also farther south test pits have been sunk in several places along the reef for about two miles. Near the middle of the reef on 316X an open cut has recently been made 47 feet long, nine feet wide, and with an average depth of 12 feet. Farther southwest a large amount of ore has been taken out and left on the dump for future use. Over 200 tons were taken from these cuttings for a mill run.

On the northern part of 337X there is a vein known as E vein, which runs nearly north and south and crosses over to 323X on the north. There is four or five hundred feet of it on the Hammond property. It varies in width from three to three and a half feet. The vein matter is white quartz, slightly charged with pyrites. A shaft six by eight feet in- side the timber has been sunk to a depth of 50 feet. Two test pits four and 12 feet deep have been sunk also, and stripping has been done to the extent of 300 feet. Almost in line with the open crosscut on the reef on 337X, and to the west, is a quartz vein known as B vein. It runs east and west, and has been traced about 660 feet. An in- cline seven by nine feet in size has been sunk 127 feet on it. This vein has maintained an almost constant dip of 22° from the surface to the bottom of the incline, which is some- thing unusual; and it shows a width of from two to three feet.

Other veins on the Loca- tions.

On my visit of December 10 I found that all mining had ceased for the winter, as there was sufficient ore on the dump to supply the mill until spring.

In the shafts drilling is all done by hand, but machine drills operated by steam are used in the open cut. There are four of these, but only two are in use at a time.

Tramways at the Reef Mine.

A tramway a third of a mile long connects the open drift on 337X with the mill. It runs through the crosscut and branches into the drift. A tramway also runs from B incline, and a pole road from E shaft to the crosscut, connecting with the tramway to the mill. At B incline there is a tramway extending to the bottom, and a steam hoister at the surface for raising the cars. There are five cars in use altogether. In the open cut cars are filled from a bucket which is raised by a derrick. One boiler supplies all the power for hoisting and drilling in the open drift and raising cars at the incline. At the mill the cars are hauled up an incline from the end of the main tramway to the crusher.

A ten-stamp Mill in running order.

A 10-stamp mill has been completed and has been running since the middle of October 1897. Although it is now treating the ore from the open drift principally, it has been largely used for making mill runs from ore taken from other parts of the reef. It is really more of a test mill than anything else, being too small to deal economically with such a body of low grade ore ; and it is likely to be supplanted by a much larger one if future tests on the reef warrant it. The machinery consists of a Blake crusher, two 5-stamp batteries with Challenge ore feeders, two mercury traps and two Frue vanners, all from the William Hamilton Machine Company of Peterboro'. The stamps weigh 850 lb. and drop 81 times per minute. The shoes and dies are of chilled steel. The vanners have 4-foot plain belts. Power for the stamps and vanners is supplied by a 20 horse power upright tubular boiler, and an engine of the same capacity which makes 300 revolutions per minute. A separate boiler and engine of 15 horse power each are provided for the crusher.

About a mile and a quarter from the reef on the other side of Sawbill lake is a waterfall which when developed will be used for power purposes. Electricity will be the transmitting agent. It is estimated that 500 horse power can be obtained.

A circular saw has been set up outside the mill and operated by the crusher engine for cutting firewood.

The water supply in summer is got by damming a small creek which runs past the mill. But this is not sufficient in the winter time as it runs nearly dry, and a pipe has been run to the lake 1,300 feet distant, and a pump stationed there for use in the latter season.

In the summer a force of 77 men, including 30 miners, was employed altogether, but in the winter this has been reduced to 30, including woodcutters.

The buildings consist of sleeping camp, dining camp, office, assay office, workman's cottage, two dwelling houses, store house, ice house, boiler house, blacksmith shop, stable and mill building.

Condition of the Mine and Mill.

The outside works are in a suitable condition except the shaft and test pits on E vein, which should be fenced In the mill the engine and drive belt should be provided with guard railing. Mr. Hammond has informed me that these instructions have been carried out. The boiler in the pumping station was not provided with a water gauge, and the attention of the manager was directed to the clause in the Mines Act with reference to this as well as to the other necessities referred to.

It may be mentioned here that the ground is being surveyed and cleared preparatory to the erection of a 50-stamp mill on location 321X, which belongs to the Folger-Hammond Gold Reef Mines Co. It will be on the shore of a small lake which is contiguous to the reef.

Hawk Bay Mine.

Hawk Bay Mine.

Less than half a day's journey up the river from the Sawbill is the Hawk Bay mine, which is on a small bay off the Seine river. A large amount of development work has been done on this property, but unfortunately the company has been disappointed in its expectations and on September 28 ceased work altogether. Nevertheless there is a good quartz vein running northeast and southwest which has been traced about two miles, in a formation of altered granite similar to that of the Sawbill

and Hammond Reef. The vein is similar in appearance to the Sawbill also, but not so wide. There are two veins on the property ; the other being close by to the west, but not traceable so far. Four shafts have been sunk on the main vein ; two about 200 yards apart on the Hawk Bay property, and two on the location to the north through which the vein runs No. 2 shaft, which is six by eight feet inside the timber, has been sunk to a depth of 122 feet and five feet of drifting done at the bottom. The vein averaged about two feet in width. Mr Wiley of the Sawbill, who is one of the chief promotors of the company, told me that the vein kept the same at the bottom but depreciated in value, hence the reason for the discontinuance of work. No. 1 shaft is about 75 feet deep. Both shafts are securely covered with heavy trap doors and provided with shaft' houses. On the adjoining location to the north a shaft has been sunk 60 or 70 feet, and south of this two or three hundred yards another one 12 feet, in which the vein showed well.

A Rand air-compressing plant had been installed, but will be removed shortly. Machine drills were used. There are three hoisters ; a compressed air one at No. 2 shaft, one operated by steam at No. 1, and a horse power hoist which had not been used.

The buildings consist of cooking camp, two sleeping camps, store house, stables, office, dressing room, powder house, engine house, blacksmith shop and two shaft houses.

Island Falls Locations.

Mr. James Hammond, manager of the Hammond Gold Reef, wrote me upon re-

Island Falls Properties.

quest on December 24 with regard to a property near Island Falls consisting of location AL282,, which had been worked all summer, and which is proving to be of considerable importance. The formation here is altered granite, similar to the Sawbill. So far only one vein has been discovered. This crosses the location at a strike of N. 57°E. approximately, and dips 65° southwest. There was not on the whole length of the vein any outcrop coming to the surface, but it has been exposed at a number of places by pits and shafts, and Mr. Hammond informs me that he has since traced it across six locations to the northeast and is sinking test pits on the same. Eight test pits and a shaft have been sunk, or are in the course of sinking, on the location. Mr. Hammond informs me that he has just returned from there and that the shaft is 95 feet deep. The property was applied for in June, 1897, and work has been going on continuously from that month, but it appears that there is a rival claim and the dispute has not been settled yet.

Mr. Hammond also writes me concerning another property in which he is interested, viz., locations AL298 and 299, near Island Falls, which is owned and worked by the Roy Mining Company. Work commenced in the latter end of December. Two pits and a shaft are being sunk and good camps have been built.

Work is going on at several other places in this part of the country, which will be referred to in Dr. Coleman's report.

Clearwater Locations.

While on my way down the Seine river about ten or twelve miles from Sawbill on

Clearwater Mining Company.

October 15th I met a party on a portage coming up. Mr. J. A. Steele, manager of the Clearwater Gold Mining Company's property, northeast of Eye lake and south of Clearwater lake, was one of the party, and I got the following notes from him : They are a Michigan company with the head office at the mine. The property consists of locations WR56 and BJ13. 14, 15 and 16. There is a force of twelve men, eight of whom are miners. A number of veins have been discovered on the locations, but only two are being worked. One vein is a contact between the granite and the schist. A seven by nine foot shaft is down 11 feet and a tunnel is in seven feet.

We stopped that night at a log hut a few miles further down the river which was occupied by a lone Swede, who was left there, he said, by a party of miners who were to commence sinking a shaft in the vicinity right away.

I walked in to Lake Harold mine the next day, but found no signs of life.

Mines of the Lower Seine

The Lower Seine River or Shoal Lake country is one of our most important mining regions. This year a large amount of development work has been done there, and there are now several important mines in that section. The largest of these is the Foley, which has been described in previous reports.

The Foley Mine.

I visited the Foley Mine on July 12, October 25 and December 23. On my first visit Mr. Joseph C. Foley was manager and Mr. R. H. Flaherty engineer, but in the latter part of July Mr. W. M. Strong, M.E., was appointed to fulfil both of these positions, and Mr. Foley was made inspector of the mine.

As is well known, the formation here is protogine, and it contains a great many quartz veins. Thirty-two have been discovered on the three locations so far, besides a number of small stringers. More or less stripping has been done on all the veins. The Daisy, on AL 75, has been stripped 170 feet. The Lucky Joe on the same location has been stripped 180 feet and traced 625 feet. The West vein on AL74 and 75 has been traced 2,865 feet. Eleven shafts have been sunk on the different veins. Two are on AL76, one 12 feet deep and the other 17 feet. On AL75 there are the Lucky Joe, 71 feet; No. 5, 113½ feet; No. 1, 13 feet; No. 3, 15 feet; North shaft, 309 feet; West shaft, 8 feet; No. 9, 31 feet; Daisy, 16 feet; and one other 12 feet. Recently a small test pit has been sunk on the Lucky Joe vein 8 feet, and about midway between the Lucky Joe and No. 5 shafts an open cut 30 feet long and 14 feet deep has been made on a newly discovered vein. The Lucky Joe shaft, which is 5½ by nine feet in size, has been sunk 71 feet, and is discontinued for the present. Thirty feet from the surface a level has been driven north 37 feet and one south 36 feet. No. 5 shaft is eight by nine feet in size and has been sunk 113½ feet and discontinued for the present also. At a depth of 50 feet from the surface a level has been driven south 80 feet, and one north 60 feet. At a depth of 100 feet a level has been driven north 7 feet.

Extent of development work.

All work is now being confined to the North shaft, on the Bonanza vein; although arrangements have been made in the air compressing plant for the continuation of work in the two former shafts later on. The North shaft is 10 by seven feet, and has been sunk 309 feet. At the depth of 100 feet a level has been driven south 61 feet, and one north 37 feet. At a depth of 150 feet a level has been driven south 165 feet, and one north 113 feet. At a depth of 200 feet a level has been driven south 89 feet, and one north 150 feet. At a depth of 300 feet a level has been driven north 101 feet, and one south 28 feet. In the second level south, at a distance of 147 feet from the shaft, a crosscut has been driven west 104 feet, cutting the Jumbo vein at the end. A winze connects the first and second levels 50 feet south of the shaft. In the first level south, at a distance of 12 feet from the shaft, a 35-foot raise has been made and connected with the shaft at the top by a small drift about one foot square, for ventilation purposes. There are two winzes between the second and third levels; one 77 feet south from the shaft and one 50 feet south. Ten feet from the shaft in the third level south an inclined winze has been sunk and connects with the shaft 28 feet below the level. At a distance of 77 feet north from the shaft in the third level a winze is being sunk to connect with the fourth level and is 73 feet deep. In the fourth level a raise is being made to meet this winze, and there is about five feet of rock yet to go through. In No. 1 level north there is 25 feet of overhand stoping with a raise of eight feet. In No. 3 level north all the ore from the winze for a distance of 46 feet north has been stoped out up to the second level and for a height of 70 or 80 feet above it. In No. 3 level south overhand stoping has been carried in as far as the winze connecting with the second level, with an average raise of three feet above the roof of the level. Fifteen feet from the shaft in the north drift at the fourth level an inclined raise is being made which slopes to the north. The highest point is

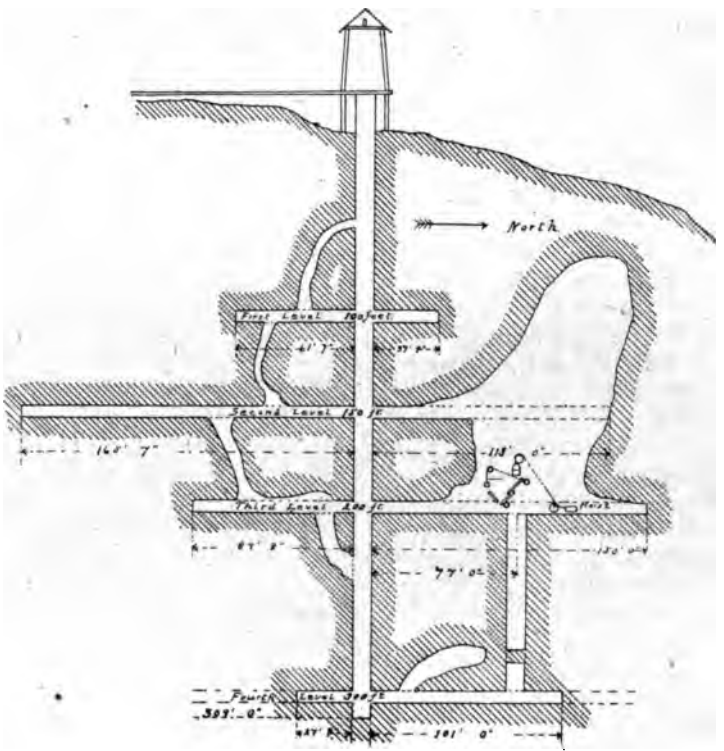
The North or Main shaft.

25 feet above the roof of the level. Stoping is being done in it. Sinking and drifting are done by contract, and stoping by the day's work.

With the exception of a slight extension of the north drift in the 200-foot level no work has been done in or about this level since July, 1897, nor will there be in future. Below this the vein is much wider and mining work can be carried on more profitably.

quartz. At the bottom of the shaft it is four feet between walls, but more than half is country rock. It averages over four feet in the shaft from the 200-foot level down. Free gold is not very common in the main shaft, although plenty of good specimens are got from the Lucky Joe. The concentrates average about one per cent.

All drilling and hoisting at the three shafts will henceforth be done by compressed



Foley Mine. Longitudinal section of North shaft on Bonanza vein.

On July 12 Mr. Foley gave me these measurements of the widths of the vein in the first three levels. First level south, 13 to 19 inches; north, 16 inches on the average. Second level south, 16 to 18½ inches; north, 24 to 36 inches. Third level south, 13 to 18 inches; in the stope at north drift, 60 to 96 inches, but only 12 inches at the end of the drift. The vein improves considerably below the 200-foot level. In the winze to the north it is seven feet wide at the top, five feet at a depth of 32 feet, and averages six feet, all

July measurements of the Main Shaft.

air. An air-compressor has been installed in the mill and transmits the compressed air to the shafts. The north shaft is nearly a mile from Shoal lake, where the stamp mill is situated. The Lucky Joe and No. 5 shafts are close together, and over half a mile from the lake on a line between the main shaft and the mill. The ground has a general rise from the lake to the shafts. The compressor is a Rand duplex, class B. It has a capacity of 12 No. 1 drills, but at present eight only will be operated, all in the the North shaft; four are in use now.

Machinery of the Mine.

Three receivers have been placed, one at the compressor 16½ feet long by 4½ diameter, one at the Lucky Joe and No. 5 shafts 16 feet long and four diameter, and one at the north shaft of the same dimensions. An air pressure of 90 lb. will be used. A six-inch feed pipe has been laid to the receiver at No. 5 and Lucky Joe shafts, and a five-inch from there to the North shaft, making 4,380 feet altogether. The pipe down the North shaft is three-inch diameter. The plant is all from the Jenckes Machine Company of Sherbrooke, Que. Hoisting in the North shaft is done by skip and in the other two by bucket. The skip-road has been completed to the 300-foot level. A 3,000 lb. skip is used. Tramways have been laid in the levels, and cars convey the ore from the working faces. A 40 horse power hoister operates the skip. The drum was originally 42 inches diameter, but this was too large and strained the engine too much in starting the loaded skip, so a 30-inch drum was substituted and was found to give good satisfaction. The engine has to be run faster, but is quite capable of so doing. A new cable has also been put in. It is 800 feet long and ¾-inch diameter, made of plough steel, 16 strand and a hemp centre. It has been tested to a breaking strain of 18 tons. The old cable was ⅞-inch diameter. A 40-inch sheave is used. The skip is raised 40 feet above ground and automatically dumped into a large pocket with a capacity of 50 tons.

A tramway 4,380 feet long is built from the pocket to the mill. Three cars, with a capacity of four tons each, are filled from underneath the pocket and convey the ore to the mill by gravity. They are drawn back by horses. Down in the North shaft are two hoisters also driven by compressed air ; one will be used for sinking below the 300-foot level until a sufficient depth has been reached to put in a skip-way. The other was used for sinking the winze in the north drift at the third level. The ore was raised into a pocket which had been constructed in the stope above, and the cars in the level were filled from the pocket. There is an engine house at No. 5 shaft, with two hoisters, an air compressor, two boilers and a tank. The hoisters, which are 25 horse-power, will probably be used at this and Lucky Joe shafts when work commences in them.

Tramming from the Shaft to the Mill.

The mill, which was built last winter, has been running more or less all summer. The machinery, which is from Fraser and Chalmers works, consists of four 5-stamp batteries with Tulloch feeders, four Frue vanners, a Comet B crusher and an elevator for raising the ore from underneath the crusher to the bin above the stamps. This bin has a capacity of 250 tons. The stamps weigh 850 lb., and drop 86 times per minute. The height of drop is six inches. The vanners have six-foot plain belts. The concentrates are being saved with the expectation of treating them with the cyanide process at some future date, or else shipping. Power for the air compressor and the mill is furnished by three 60 horse power boilers. A 60 horse power Corliss engine operates the mill.

The Stamp Mill

For the past few months the work has been confined to development altogether, and the running of the mill has been intermittent. An average of 250 tons per month, the product of development work, has been milled just to get it out of the way. The mill was shut down on December 20 as it was found that ore could not be hoisted conveniently until the shaft has been sunk below the present tice at the fourth level. It is the intention to start up on January 1 however, and run the mill continuously from that time on.

There is a dock at the lake, and a pump upon it for supplying the mill. There is also a derrick on the dock for raising heavy pieces of machinery from the boats to the car which runs to the mill.

The shaft is timbered for a depth of about 20 feet, the walls below being quite solid. The ladder-way was in a bad condition at the time of my first visit but has since been attended to and is now quite safe for ascent and descent. The ladders are placed at suitable angles, and platforms have been placed at suitable distances apart. It is all cased off except the portion between the third and fourth levels where one or two boards have been left off the casing so that injury may not result to from blasting in the shaft. This will be closed up when the shaft has been sunk

Condition of the Mine and Mill.

little deeper. The skip-way is properly fenced at the different levels. The fencing at the surface of the shaft has not been carried all around, and instructions have been left to have this done. It would also be advisable to fence or securely cover the winze in the third level, since hoisting has been discontinued there.

A large amount of fresh air is forced into the mine by the compressor, and the ventilation is good. The water is raised by the skip.

Lucky Joe and No. 5 shafts are securely covered at the surface.

The machinery in the mill has all been provided with guard rails where required, except the new compressor, for which a railing is being made.

A dressing room has been constructed at the North shaft as required.

The total force amounts to 48 men altogether at the present time. After January 1 it was intended to have 20 miners, including both shifts in the North shaft.

Buildings on the Property.

The following buildings are on the property in connection with the mine: Three engine houses, three shaft houses, warehouse, blacksmith shop, assay office, two dressing rooms, three boarding houses, four extra sleeping camps, office, two barns, mill and compressor buildings, powder house and several private houses. A powder thaw house has recently been built. There is also a hospital with a doctor and a nurse in attendance, and a general store, but the latter is a private venture. Two new dwelling houses have been built lately, one for the manager and one for the inspector and president of the company.

Good wagon roads have been constructed where required on the property.

A large amount of clearing has been done, and AL76, which borders on the lake and contains 108 acres (50 cleared), has been surveyed for a town site.

A small 7 horse power steamer called the "Wanda" belonging to the mine runs on the waters of the lake and river.

Olive Mine.

Another mine in this section which is attracting considerable attention by its unusual richness is the Olive, situated on the southern shore of the western end of Little Turtle lake. The property consists of locations G60 and 61, belonging to the Preston Gold Mining Company, Limited. W. A. Preston is manager of the mine. It is reached from Mine Centre by a good sleigh road in the winter time by way of Bad Vermilion lake; in the summer the route is the same, but the lake must be crossed by canoe. The total distance is nine miles, of which three is on water. I visited the place on July 10, October 20 and December 22.

Preston Gold Mining Company.

Phillip LePage and W. Preston, the latter a nephew of the manager, had been prospecting the location since August, 1896. I got the following notes on the prospecting work which has been done f om Mr. LePage: Two veins have been found; one, the main vein, can be traced about four miles altogether, crossing both locations. It has a strike of about 7° north of east. No. 2 vein is parallel to and about 25 feet north of the main vein. It has also been traced across both locations The country rock is diorite, but there is a formation of green schist which encloses the veins and runs along in the same direction. The main vein has been stripped most of the way on G60, and considerable stripping has been done on No. 2. Test pits have been made on the veins in a number of places from three to 10 feet in depth, mostly on the eastern side of the property. On the water front of G60 there is an outcropping showing large quantities of iron oxide. A test pit has been sunk and some quartz taken out, but very little work has been done on it. Assays so far have been low.

Prospecting the Property.

Three shafts have been sunk on the main vein to depths of 118, 65 and 62 feet. The main shaft, which is five by nine feet inside the timbers, is 118 feet and is being continued. Sixty feet from the surface a level has been driven east 81 feet, and one west 38 feet. The drifts are also being continued. It is the intention to sink 150 or 180 feet and then crosscut north and south. Sixty feet east of the main shaft is No. 3, or the air shaft, which is on the average five by five feet in size and 62 feet deep. It was commenced a few feet

Shafts sunk on the Locations.

north of the vein and sunk vertically until it reached it, about 20 feet down. From this point it was continued on the vein to the present depth, where it is connected with the drift from the main shaft. Overhand stoping has been commenced near the air shaft in the drift.

About 250 feet east of the main shaft a six by nine shaft has been sunk on the vein to a depth of 65 feet. It is discontinued for the present, but a platform was lately built about 20 feet from the surface for the purpose of examining the vein at that point, and it is likely that operations will be continued here in a short time.

All work at the mine is done by contract. The next 50 feet in the main shaft has been let at $18 per foot. Hoisting, blacksmithing and the lander are supplied free, which amounts to about $5 more per foot. The shaft is six by 10 feet full size. Drifting is costing $12 a foot, not including the hoisting and blacksmithing, which amounts to $3 more. The drifts are four by six feet in size.

The vein is rather peculiar in its nature. There is a narrow but persistent vein of quartz which is very rich, and about a foot of country rock of a schistose nature on either side, which carries sufficient gold for milling purposes. The quartz is five or six inches wide in the bottom of the shaft, and from six to 18 inches in the drifts. Several small quartz stringers are coming in at the bottom all across the shaft. In No. 3 shaft the quartz is three feet at the widest point, and about six inches at the narrowest, averaging about two feet. In the test pits it shows from a few inches to three or four feet in width.

Peculiar nature of the Vein.

In the main shaft the assays run from $40 to $250, and the average is about $110. This is the pure quartz. The schistose matter next to the vein runs from $7 to $20; and where quartz other than the regular vein occurs in the shaft it assays from $5 to $10.

Drilling is all done by hand, but it is the intention to have an air compressor and machine drills in before long. In the main shaft a steam hoister and bucket are used. A tramway about 250 yards long runs from the shaft to the mill. There are two cars in use which run to the mill by gravity. A pulley is being fastened to the hoister which will operate by belt a drum for drawing the empty cars up the tramway to the shaft.

Machinery, Mill and Buildings

The ore is treated in a small mill made by Fraser and Chalmers. The machinery consists of a 2-stamp gravity battery, with a Challenge ore feeder, a No. 2 Blake crusher, a mercury trap and a Frue vanner with 6-foot plain belt. The stamps weigh 1,000 lb. each, and drop 7½ or eight inches with a speed of from 105 to 108 per minute. The battery is four-discharge. Power is furnished by a 20 horse power boiler and a 15 horse power engine. The water is pumped from the lake, which is only a few yards away.

The buildings consist of a sleeping camp, office, cook camp, three extra sleeping camps, store house, blacksmith shop, mill, engine house, shaft house and a private dwelling. A new dining room, kitchen and a private dwelling house have lately been put up. The buildings are mostly frame.

A saw mill with a capacity of 1,000 feet per hour is situated near the mill and run by the engine of the latter. There is plenty of good timber on the property for mining, building and fuel. It consists of spruce, poplar and Norway pine.

There is a total force of 34 men, including 14 miners, and four Indians employed to chop wood, etc.

The main shaft is timbered for a depth of 15 feet. A suitable ladder-way has been constructed to the first level according to the Mines Act. But the shaft at the surface must be provided with a proper fencing, and also the bucket way at the first level. Where stoping has been commenced the stulls for supporting the miners are not sufficiently strong for the purpose, and the attention of the manager was directed to this fact.

Condition of the Mine.

Proper ventilation is easily secured in the cold weather, but in the summer time it was not good. A ventilating apparatus consisting of a wooden boxing extending down the shaft, and through which air was forced down by a bellows, proved a failure. For this reason they were compelled to work one shift only in summer, and blast in the evening; the air was then pure on the following morning. But

the air-compressing plant, when installed, will remedy this difficulty. No. 2 shaft must be fenced while work is discontinued in it.

An Inspector's Book was left, and notices posted up.

A fatal accident occurred at this mine in No. 1 shaft on August 20, 1897, and under instructions from Mr. Blue I investigated the same and sent in a report.

Golden Star Mine.

Golden Star or Randolph Mine.

One of the new properties which promises to make an important mine in the future is the Golden Star, or better known as the Randolph mine, which is situated about four and a half miles north of Mine Centre, on the Government road. It consists of locations AL114 and 116 and is owned by the Golden Star Mining and Exploration Company. Mr. W. J. Merritt is manager of the mine and Mr. C. J. Stone is engineer.

The discoveries on the property were made by Neil Berger and Edward Randolph in August, 1894, and it was purchased by the present company in March, 1897. But previous to this it had all been prospected. Work commenced on March 22 of the latter year. I visited the place on October 22 and December 23.

The country rock is green schist, diorite and very fine-grained green stone. The ore bodies consist of a large felsite dike and a number of small quartz veins a few inches wide which occur at different places on the property. A little blasting and test pitting has been done on some of the latter. They are very rich, but are only considered of secondary importance on account of their size.

The main ore body is the dike, which is called the Hunky vein. It has rather undefined boundaries, but is probably about 20 feet wide and has been traced a few hundred yards. The ore is the quartz, which occurs as a vein in this dike. The quartz has been traced three or four hundred feet on thesurface. The strike is northwest and the dip as obtained in the shaft is vertical for 54 feet and then 70° to the southwest for the remainder of the distance.

On AL114 a shaft is being sunk on the main vein, and three test pits from three to six feet have been made to the southeast of the shaft. The latter has reached a depth of 135 feet. It is 4½ by eight feet inside the timber for a depth of 40 feet, and five by eight feet for the remainder of the distance. The first level is 74 feet from the surface. A drift runs north 107½ feet along the vein and one south 80 feet One hundred feet from the shaft in the north drift a winze is being sunk, which was 40 feet deep on December 23. There is a sump with a capacity of 150 cubic feet close to the shaft in the north drift.

Workings on the main Vein.

Like all felsite dikes, the walls are distinct in the shaft. The quartz is five feet wide at the surface, two feet of which is a rich pay streak. It widened out to six feet or the full distance between the walls, at a depth of 27 feet, and was all rich. At a depth of 32 feet the quartz pinched out entirely with the exception of some small stringers in the felsite. Fifty-four feet from the surface the quartz came in again and is quite persistent from this on. It gradually widened to three feet and has maintained this width to the bottom of the shaft. In the south drift it varies from three to seven feet of solid quartz. A couple of "horses" come in along the drift. At the end of the north drift there is 20 inches of quartz. At the bottom of the winze there is 18 inches.

The shaft seems to have been sunk in a very much oxidized and soft part of the vein, while on both sides of it the vein is quite solid. Copper and iron pyrites, galena and free gold are plentiful. The assaying is all done in Duluth, and not many reports reach the mine; but Mr. Stone, the engineer, thinks that the average is about $30 per ton. A mill test of 500 lb. taken from across the dump and sent to New York yielded $49 to the ton and was 80 per cent. free milling.

All drilling is done by hand. A small steam hoister, with a 30 horse power upright boiler, a half-ton iron bucket and wire cable constitute the hoisting machinery. Tramways are laid in the levels and the bucket carried on trucks. A No. 7 Cameron drainage pump is used.

The buildings consist of a boarding camp, office, engine room, shaft house, blacksmith shop, store room, barn and root house. There is a total force of 28 men, including 13 miners

The shaft is well timbered to the first level, and a man-way with ladders and platforms properly arranged has been cased off to this point. Trap doors are provided for the bucket way at the first level and at the surface; but a fencing must be provided at the latter place as required by the Mines Act.

Condition of the Mine

After blasting the smoke and gas are cleared out by means of air which is forced down by a "Buffalo" blower through a 7-inch canvas pipe, which leads to the bottom of the shaft and can be connected to branches in the drifts.

An Inspector's Book was left and notices posted up.

The work in the mine is done by contract. The cost of sinking the shaft to the first level, including timbering, etc., was $20 to $23 per foot. But it must be remembered that, as stated before, it is sunk in a soft part of the vein. The contract to sink 100 feet from the first level was let at $16 per foot, not including timbering or hoisting of course. The north drift had been contracted for at $6 per foot, and the south at $8. The other levels will be 100 feet apart, so that the mine can be worked by 100-foot stopes.

If the vein continues to show as satisfactorily as it has done up to the present a Fraser and Chalmers mill will be brought in shortly. The mill site will be on Bad Vermilion lake, which is about half a mile from the shaft, and from which a tramway may be constructed to carry the ore by gravity.

AD2 Mine.

Near the Golden Star Mine and about four miles from Mine Centre are three locations, AD 2, 3 and 4, which are the property of the AD 2 Gold Mining Company, with head office at Mine Centre. The discoveries were made by Mr. William Fawcett in April, 1894 At this time the country was all green and overgrown with timber, which made prospecting difficult work. A fire swept over it in that year, cleaning off the rock, but also destroying most of the timber. A little work was done in the spring of 1894, and some test pitting in the months of April, May and June, 1895. Nothing more was done until May, 1897, when the present developments commenced and have been continued all summer. I visited the place on October 23 and on December 23.

The AD2 Mine.

The formation here is protogine and fine grained greenstone. There are five principal veins on the property; the Contact, Moose, Gem, Lucky Coon and Bartley, which are similar in nature to and are really in several cases extensions of the Lucky Coon and Ferguson veins, which properties adjoin on the south and east. The Lucky Coon vein is so called because it is a continuation of one of the principal veins on the Lucky Coon property. It has been traced about 3,000 feet altogether and crosses AD4. The strike is N. 50° E. A little blasting has been done at one point and it shows a width there of about 20 feet, but only three or four feet of this is quartz, the rest being protogine. The Bartley vein crosses the southwestern corner of AD4 and runs nearly northwest. The Moose vein is traceable the farthest of any; it has been followed across AD2 and several miles beyond, outcropping, it is claimed, on the other side of Bad Vermilion lake. The strike is the same as the Lucky Coon. The gem vein runs from AL117 to the east across AD2 and is traceable for a distance of about three-quarters of a mile. The strike is 7° south of east. It is supposed that this and the Moose veins join at the western boundary of AD2. The Contact vein has been traced across the north end of AD2 and south of AD3, for a distance of a mile altogether, including half a mile on the Ferguson property. It is on the contact between the protogine and the greenstone for a few hundred feet, and then runs into the former. A test pit has been sunk on it to a depth of nine feet. The vein is from 12 to 16 inches wide in the pit, but farther east the width averages two or three feet.

Veins on the Property.

Two test pits have been sunk on the Moose vein about six feet deep. A tunnel has been driven east on the vein for a distance of 116 feet. Sixty feet from the entrance a crosscut has been driven north six feet, and one south 20 feet About 145 feet east of the mouth of the tunnel a shaft is being sunk on the vein with the purpose

Development work.

ınecting with the tunnel. It is now 10 eep and will be continued below the l when the latter is reached. The vein ges seven or eight feet in width in the l and test pits. It consists of quartz ountry rock.

the Gem vein a tunnel has been driven 35 feet. Sixty feet from the mouth a has been sunk from the surface to a of 74 feet, and is 49 feet below the l. The intention is to sink the shaft t below the tunnel and drift along the The same will also be done in the case Moose tunnel. The vein averages 2½ n width in the tunnel and has been ally widening in the shaft until at the n it is four or five feet and only one wall ed. The vein matter at the bottom is y country rock, but it all carries gold. hundred feet east of the tunnel a shaft een sunk 40 feet, but it is now partially with water. The vein is well defined as can be seen, and ranges from 2½ to feet in width.

lling is all done by hand, and hoisting ndlass and bucket. A No. 5 Cameron ge pump is used in the Gem shaft.

Dean's steam 2-stamp mill made by ott of Duluth, Minn., is on the pro- and was run for a while, but did not atisfacton and will be replaced by a y mill in the spring, or as soon as pments warrant it. Power was fur- by a 25-horse power boiler, but this d for the pump now.

re is a force of 20 men, including 12 . Work is carried on by day shift John Campbell is manager of the The buildings consist of a sleeping cooking camp, office, blacksmith shop, house and dressing room.

ructions were left to have the shafts on m vein fenced. An Inspector's book ft and notices posted up.

Lucky Coon and Ferguson preperties oth lying idle last summer, but it is expected that operations are to commence on the latter before spring. Careful reports have been upon it under instruction of the Lon- vners.

Other Seine River Properties.

On October 24 I went with Mr. John Green of Port Arthur to examine a property near the Foley mine, known as Wiegand's locations. It consists of locations AL101 to 107 inclusive. AL-107 is well wooded and the rock is therefore not exposed, but the other locations are more favorable for exploration. The ground is covered with only scattered and fallen timber, earth, moss and more or less muskeg, and with the exception of where the latter occurs the rock is mostly bared. The formation is protogine. A road leads up from the lake over AL107 to a small shack Trails have been cut to and along the different veins, which are about half a dozen in number. These have been stripped sufficiently to show their continuity. Their general direction is northwest and southeast, but they are only roughly parallel. They vary in width from a few inches to five or six feet, and much more in places. One or two have been traced for over half a mile, while the others are exposed generally only on the high ground and disappear in the muskegs. Usually good walls are shown, but in some places they are much broken up and indefinite. The vein matter is quartz, more or less charged with copper and iron pyrites and galena. Five or six test pits have been sunk at different places to a depth of from six to eight feet.

Wiegand's Locations.

The Alice A. property, up the Seine river a few miles from Mine Centre, will be mentioned in Dr. Coleman's report. I only visited the place once and in company with Dr. Coleman. But I understand that the owners have been working on it all summer with very satisfactory results. I am told also that at two or three other places near Sturgeon Falls on the Seine mining operations have commenced, and that on one property a five stamp mill has been ordered and will be set up soon.

Properties upon the Seine river.

Manitou-Wabigoon Region

In the latter part of October I passed through the Manitou country on my way to Wabigoon. A great deal of prospecting has been done in this region during the past year,

and the greater part of the country has been surveyed. A certain amount of development work has been done on a number of locations, but no large mines yet exist. Unfortunately two of the most extensively developed mines, viz., the Jubilee, consisting of location HP301 and the Upper Neepawa, location McA28, have ceased operations, for the present at least.

In the Manitou Country.

Jubilee Mine.

The Jubilee mine is situated at the head of Trafalgar bay in the Upper Manitou lake. The formation is green schist. Three veins have been found; two of which are small, but the other, the main vein, has been traced across the location and quite a distance farther. It has a strike of nearly north and south. A six by 10 foot shaft has been sunk to a depth of 75 feet on the vein. The first level is 48 feet from the surface. A drift has been run north 45 feet and one south 43 feet on the vein. The latter is four feet wide at the shaft at this level, 4½ feet at the end of the north drift, and two feet at the end of the south drift. It could not be seen at the bottom, as the shaft was partially full of water. First class timber work has been carried to a depth of 25 feet, and a good roomy manway four by six feet in size and suitably cased off from the hoisting compartment is constructed to the first level, with ladders and platforms as required by the Mines Act. The machinery for an air compressing plant and a hoist is on the premises, but has never yet been put into running shape. The compressor is a single cylinder one with a capacity of four drills. The compressor, receiver and hoister have been brought to the mine, but the boiler was left on the portage two or three miles back. The buildings consist of a boarding camp and a shaft house.

The Jubilee Mine.

Neepawa Mines.

I got the following notes on the Upper and the Lower Neepawa mines from Mr. F. W. Guernsey, who is manager for both properties. The Upper Neepawa is situated north of Trafalgar bay, about three-quarters of a mile from the Jubilee. The formation is similar to that of the latter, consisting of chlorite schist. The ore body is a band of sericite schist and quartz, slightly pyritiferous, running northeast. Two shafts have been sunk, the main shaft to a depth of 70 feet and an air shaft 25 feet. At a depth of 45 feet in the former a crosscut has been driven 35 feet east, and from the end of this a drift to the air shaft 70 feet distant. There is also at the same level in the main shaft 14 feet of drifting northeast along the vein and 18 feet southwest. The vein shows a width of 30 feet in the crosscut. Some of the finest specimens of visible gold in the country came from this shaft at the surface, and at the bottom occasional samples are found. The following are the buildings on the location: Boarding camp, (to accommodate 40 men), cooking camp, office and assay office, store house, blacksmith shop and powder house. Work commenced here in November, 1896, and ceased on about the first of September.

The Upper Neepawa Mine.

The Lower Neepawa is on the northwest shore of the Lower Manitou lake, and consists of location HW54, which contains 40 acres. The formation is similar to that of the previous properties. There are seven veins altogether, but only one is being worked. This can be traced for miles and has a strike of N. 50° E. The dip is 75° or 80° southwest. A little stripping has been done and a few shots put in here and there along the vein, but very little is known of its size from surface indications. A seven by nine shaft has been sunk on the hanging wall to a depth of 65 feet. A crosscut has been commenced at the bottom. There is 11½ feet of quartz at the bottom of the shaft and only the foot wall reached. Sixteen feet of vein matter has been exposed at the bottom altogether. At this depth a pay streak in the vein assays from $5 to $140 per ton. The intention is to sink to a depth of 100 feet and then drift. This mine has been closed since September last, but Mr. Guernsey intends to commence operations again immediately. The first work on the property dates from March, 1897. Sleeping and cooking camps are provided.

The Lower Neepawa Mine.

On the north end of Manitou island, which is near the Lower Neepawa, is a property

known as the Bee-hive mine, where I am told a number of men are employed in testing and developing a vein, but I did not visit the place and can give no particulars.

The Bee-hive Mine.

Quackenbush Location.

On HP375 west of Mud lake the Quirk Bros. have taken a contract to sink a 100-foot shaft on one of the veins. The property is owned by Mr. V. Quackenbush of Dakota, and his brother-in-law. The formation is green schist. There are two veins in the location; one running north and south, and another, on which the sinking is to be done, N. 20° E. The width of the latter varies from a few inches to several feet, and it is traceable for a few hundred feet on this location and is believed to be a continuation of an important vein on an adjoining property. A five by seven shaft will be sunk and was to have been commenced on November 2. The first 50 feet was contracted for at $25 per foot; and the next 50 feet at between $28 and $30, including the furnishing of everything, such timbering, hoisting, blacksmithing, etc.

Quackenbush's Property.

Northern Queen.

About two miles north of Wabigoon is the Northern Queen mine, which was worked last winter, but has been closed down all summer. The vein is traceable for several hundred yards, and it is said for miles. Shots have been put in at several points A seven by nine shaft has been sunk to a depth of 40 or 50 feet. The vein where the shaft is sunk shows a very large per cent., much more than half, of iron pyrites, and hence would be expected to be too refractory for the extraction of the gold by the free milling process; but this peculiarity might be confined to only a small portion of the vein.

The Northern Queen Mine.

Locations near Dryden.

Early in July Dr. Coleman and I visited some properties at Dryden. We found testing and developing going on in a number of places. A report of these will likely be made by Dr. Coleman. On November 18 I visited Dryden again and learned that, although operations had been continued until late in the season in several cases and some satisfactory discoveries made, all the properties that I had visited with Dr. Coleman previously were standing idle for the winter, and work was going on at one place only. This latter place is about a mile east of Dryden and south of the railway track. Th property consists of lots 1 and 2, concession 5 of Van Horne township. Messrs. J. Monroe and H. G. Hutchison own the property and have given an option to the Eastern Townships Mining and Development Company, Limited, for two years commencing September, 1897. Mr. Francis Bennetts is testing the property for the company and has three men at work. The formation is green schist. There are two ore bodies,—one on each lot. On lot 2 there is a large body of a fahlband nature. It runs east and west and is traceable for 500 feet. It shows a width of 40 feet at one point where test pits have been sunk. The surface is much oxidized and a little quartz is contained in the vein matter. A few test pits have been sunk at different points along the ore body; two of these are on opposite walls at one point. One has been sunk nine feet and discontinued; the other has reached a depth of 14 feet, and is continued. This latter will be sunk at least 75 feet, and a crosscut made at that depth to the other wall. Assays of this ore body run from nothing to $20. On lot 1 there is a vein of white quartz which I saw at one point only, but which was four feet wide. It extended up the face of a bluff about 20 feet high, and is said to be distinctly traceable at the top for some distance. A test pit has been sunk a few feet upon it. Assays run from $7.10 at the surface to $8.50 at the bottom of the pit.

Properties near Dryden.

Locations in Van Horne township.

The New Klondike District

Early in November I visited that part of the country south of the track, between Tache and Brulé, known as the "New Klondike." The best finds were being made five or six miles from the track. There is a small section of country there containing not more than a few square miles which is being rapidly taken up. The

An attractive Region for Prospectors.

formation is principally felsite, but trap occurs also to a certain extent, and the contact with the granite is within three or four miles of the track. The country is very thickly wooded with small evergreens, and although fires have swept through and cleared a large part of it, there is still much difficulty in prospecting The ore bodies are mostly quartz veins. The quartz is largely of a dark blue or smoky species; some veins are entirely of this nature, while others are composed solely of white quartz and some vary from one to the other. In width they average from a few inches up to eight or 10 feet, and some outcroppings show a width of 40 or 50 feet.

One very promising looking location is 416HW. Near the centre of this location is a vein with a strike of northeast and southwest which is traceable for about 150 yards. It ranges in width from two to four feet and shows distinct walls. The accessory minerals are copper and iron pyrites, malachite, azurite and free gold. Some native copper specimens, which although on a small scale were very striking, were found here also. Several pannings were made during my visit with very satisfactory results. There are a number of other large outcroppings of quartz on this location which run from six to eight feet in width, but which have not been traced continuously, and as they would indicate considerable variation in the direction of the vein it is a question whether they are all separate bodies or form two or three veins. But this can be proven by stripping. I saw several other veins belonging to the same parties, and they gave evidence of being well worth testing.

Location 416HW.

Messrs. Walker and Brown, who are partners in a number of locations, are the pioneers of this section. Unfortunately I did not see them while on my visit, and hence did not examine their properties.

Messrs. H. Lowry and C. W. Hale are operating together on a number of locations in the same vicinity. They have disposed of a half interest in their properties to a company, and camps have been erected and development work will be commenced right away. I saw some of their veins and they appeared to be very good.

Before leaving this part of the may say that several reports are ma coveries around lake Mi I did not visit this part told that development is going on two places and that a number of have been surveyed. Lake Minn reached by road from either Wab Dinorwic. A wagon road is being the former place, and there is a wa canoe route from the latter plac distance is about 35 or 40 miles.

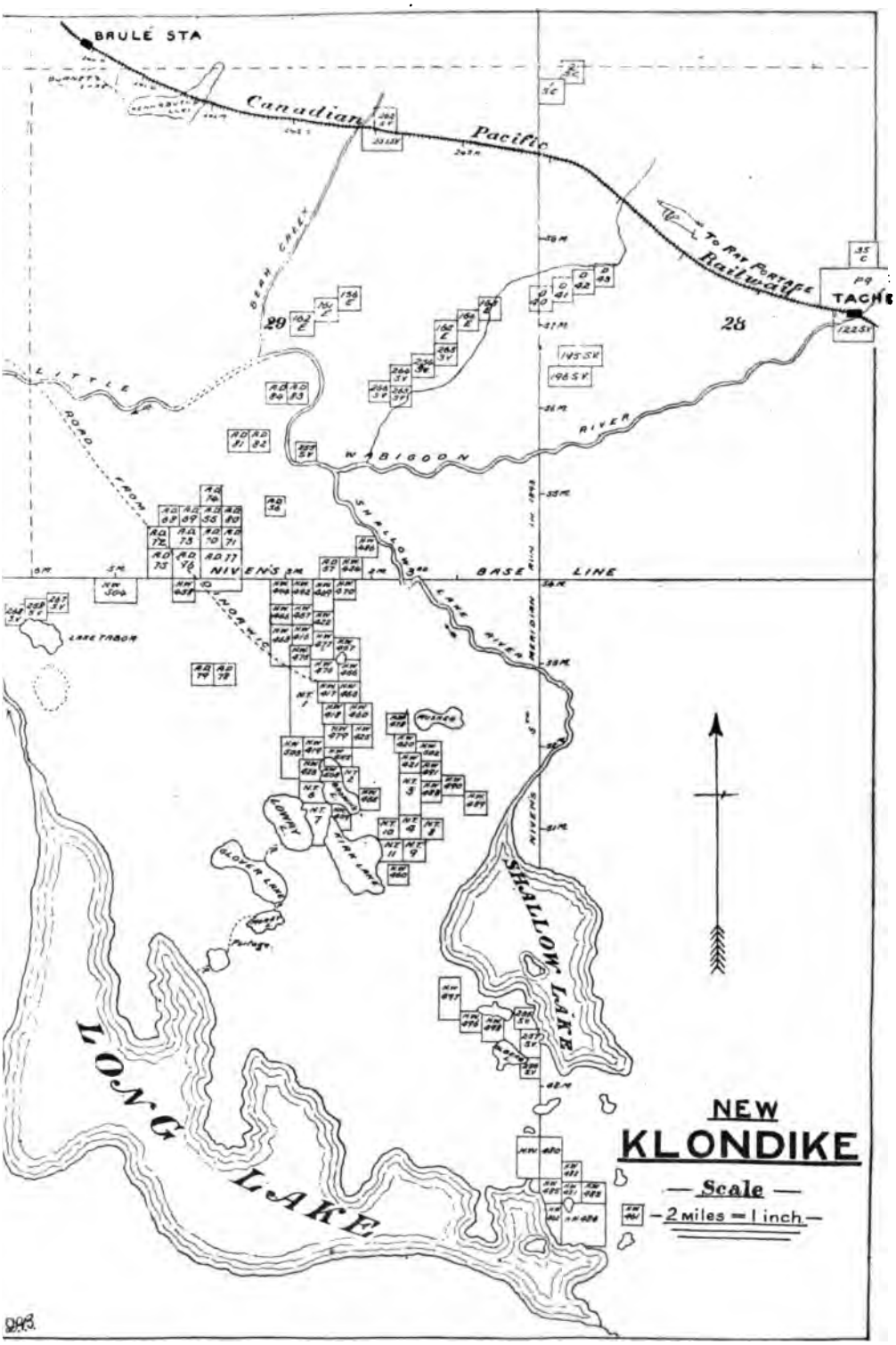
Lake Minnetakie

Mines north of Lake Sup

I spent several weeks last summe Jackfish, north of Lake Superior, an a few properties which I will next

South of the track at Schreiber is of iron pyrites which is being mined manufacture of sulphuric the Davis Sulphur Ore C of New York. The loc R606, containing 40 acres. A mar Morley owned it originally and little work upon it. He sold out present company in the spring of 1 they began operations on June 23 same year. Prof. Willmott and I vis place on July 25. The deposit is ap a vein. An open cut has been made 100 feet long and averaging 12 feet i The contents of the ore body are py pyrrhotite, which occur in distinct close together. There is 50 or 60 pyrite with an average width of 2½ f alongside of this the pyrrhotite, whi greater extent, but valueless. So far cally nothing is known as to what the of the deposit will prove to be, but it mined as long as it continues to pay open cut is on an elevated portion of and a tunnel has been commenced n foot of the hill with the intention of at the body lower down to make the w mining more economical. Both the and pyrrhotite are taken out, but the only is saved. There was about one h tons of it on the dump on the day of ou and five weeks later the manager in me that this had been increased to four or five hundred.

Iron Pyrites Mine at Schreiber.


BRULE STA
Canadian Pacific
To Ray Portage Railway
TACHE
BEAR CREEK
LITTLE ROAD FROM
WABIGOON RIVER
SHALLOW LAKE
NIVEN'S
3rd BASE LINE
LAKE TABOR
LOWRY
GLOVER LAKE
LONG LAKE
SHALLOW LAKE
NEW
KLONDIKE
— Scale —
— 2 miles = 1 inch —

The ore will be shipped to chemical works in different parts of the United States. It will likely be taken to lake Superior, which is a mile and three-quarters distant, and to which a road will require to be constructed. A good wagon road a mile and a quarter long leads to the C.P.R. station at Schreiber.

Several test pits have been sunk to depths of from five to ten feet at different places on the location prospecting for a continuation of the deposit, but poor success has been met with excepting in one case, where pyrrhotite was struck. The country rock is trap, and what appears to be a boss of granite occurs near the ore body. The test pits were sunk through drift material which covers the greater part of the rock.

There were 12 men employed, five of whom were miners. Two buildings, a boarding house and a blacksmith shop, have been erected.

Otisse Mine.

On the afternoon of the same day Prof. Wilmott and I went out to the Otisse mine, which was the only important place where development work on a gold vein was going on in that section of the country. This mine is about four miles east of Schreiber and about a mile north of the the railway track, from which a foot trail leads to the locations. The latter consist of 216 and 217AL, containing 40 acres each. They are owned by the Otisse Mining Company, with head office at Schreiber. Mr. S. Otisse is manager of the mine. There are five veins on the property, but work is confined to one only. It has a strike of northeast and southwest. Two shafts are being sunk 1,200 feet apart. No. 1 shaft, which is the more northerly, was 34 feet deep on the day of our visit. There is four feet of vein shown, and only one wall reached. The vein matter is quartz and country rock, charged with pyrites. No. 2 shaft was 30 feet deep, and showed 2½ feet of vein matter. There is a force of 12 men, nine of whom are miners, and work is carried on by day and night shifts.

The Otisse Gold Mine.

The Empress Mine.

Next day we went to Jackfish and visited the Empress mine, which had been closed down since May 24, 1897. Reports of this property have been made previously, but I will give a review of the extent of the work done up to date :

Prospecting has been done on four veins, a test pit having been sunk on each, and on one of them several pits. On No 1 vein a pit has been sunk eight or 10 feet ; on No. 2 vein there is a pit 18 feet deep ; on No. 4 vein there is one 12 feet deep ; and on what is believed to be the junction of Nos. 3 and 4 vein a pit has been sunk 20 feet. On these two latter veins, which are about 30 feet apart, adits No. 1 and No. 2 have been driven 46 feet and 70 feet respectively They are connected by a crosscut at the end of No. 1 adit. Fifty-five feet from the entrance, in adit No. 2, a crosscut has been driven north 12 feet. Over the adit an open cut has been made on No. 4 vein 80 feet long and about 15 feet deep on the average. A rise has been made from the adit underneath to the open cut, a distance of a few feet, about 48 feet from the entrance. A little open cutting has also been done on No. 3 vein, over No. 1 adit.

Work on the Veins.

Before mentioning the tunnel I will say a word about the conditions under which the veins occur, for the sake of completeness, although this has been all described before. With regard to the topography, the veins are on the side of a hill which rises to a considerable height (probably three or four hundred feet above the valley or depression which extends along the southern part of the location. They are all close together and parallel or roughly so, probably joining at some point to the east, as is believed to be the case. Now a tunnel has been driven north into this hill, cutting the veins at a depth to give a certain amount of stoping ground above, and also sufficiently elevated to enable the ore to be trammed over a level tramway to the rock house of the mill.

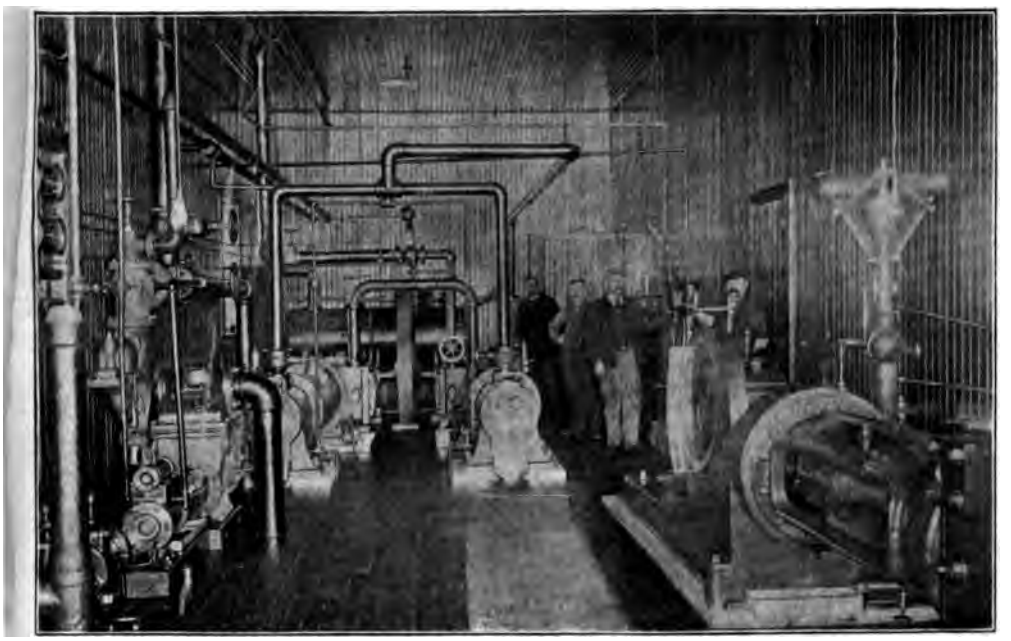
The Tunnel.

The tunnel has been driven 417 feet. At a distance of 229 feet from the entrance a drift has been made along the vein 35 feet east. At a distance of 263 feet from the entrance a drift has been carried east along a vein 82 feet and one west 31 feet. At a distance of 386 feet from the entrance a drift

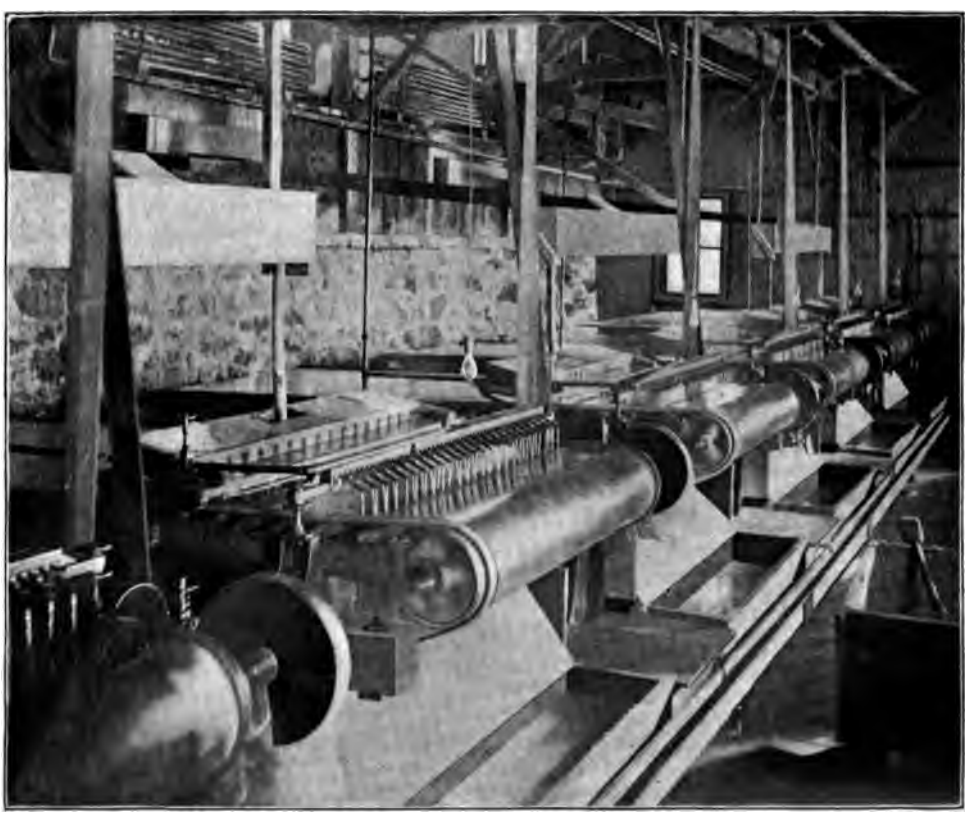
Sultana Mine. Second level, at end of south drift, p. 46.

Sultana Mine. South drift of fifth level, p. 46.

Sultana Mine. Fourth level, south of main shaft, p. 46.



Engine and ccmpressor room of the new Sultana Mill, p. 47.



Vanner room of the new Mill, Sultana Mine, p. 47.

has been made along a vein 32 feet east and 84 feet west. In drift No. 1 some overhand stoping has been done.

The Veins.

In all the drifts the veins are practically the same, being from six to eight feet wide, and consisting of hornblende schist and quartz, all heavily charged with pyrites. As a general rule the greater part of the vein matter is schist. Quartz bodies occur at one or two other places in the tunnel where no drifting has been done. There is plenty of vein matter in sight, and the only apparent reason for the discontinuance of work is that the ore is low grade. This is the general report with regard to the property, and that it can only be successfully treated by a large stamp mill.

Drilling and Tramming.

There is an air compressor, and machine drills for drilling. Tracks are laid along the tunnel and drifts, and cars can be run direct from the working faces to the mill. The mill is situated south of the tunnel, and is connected with the latter by a short level tramway which runs to the rock house above the former.

The Mill.

The machinery of the mill consists of a sizing screen, Blake crusher, two 5-stamp batteries, a hydraulic classifier, three Frue vanners, a Rand air compressor, two boilers, a steam engine, pump and tank. The machinery is kept in good condition, and is coated with oil where necessary as a protection against rust. There is a room adjoining the mill containing from 50 to 100 tons of concentrates, which are the result of accumulation while the mill was running.

An unlimited water supply in summer is got from several small lakes about 500 yards from and about 300 feet above the mill. They have all been dammed and a pipe laid to the mill. In the winter the water is pumped from a small creek which runs past the mill. A well has been dug in the same about 150 feet from the mill and a pump stationed there.

During last year a 12 by 40-foot addition was made to the mill for a new boiler and the air compressor, and a 12 by 14-foot addition for storing the concentrates. The other buildings consist of the mill building, boarding house, dressing room, assay office, machine shop, blacksmith shop, stables, grain shed, two powder houses, oil house and pump house.

Condition of the Mine.

The adits on No. 3 and 4 veins are timbered at the entrances. Test pits and shafts are all fenced as directed. A dressing room is provided near the tunnel. In the mill a guard rail must be placed around the fly-wheel, belt and crank of the steam engine when operations commence again.

Other Locations near Jackfish.

Prospects near Jackfish.

On August 2 I went out to the camp of a couple of men, Messrs. Walker and Brown, who were prospecting about six miles east of Jackfish, near the railway track. They had discovered a large outcropping of quartz south of the track, but it did not appear to be traceable any distance. North of the track one or two finds had been made; one was a large quartz vein which they said could be traced a considerable distance, and the others were large fahlbands containing more or less quartz, and much oxidized on the surface. Assays were unsatisfactory. I learned afterward that Mr. McBain of Port Arthur had an interest in some properties in this vicinity, and that the ore bodies were fahlbands.

On August 8 I visited two locations, 672 and 673X, about two miles beyond the Empress mine, belonging to Peter Nelson of Jackfish. Mr. Nelson told me that he had traced the vein four miles, and that it averaged about 10 feet in width. I saw the outcropping at two places only, about 100 feet apart. Some blasting had been done at these points and the vein showed a width of from six to 10 feet. But the rock was all covered with a thick growth of trees and muskeg, and the exposures were long distances apart, making the examination unsatisfactory. Some encouraging assays were obtained.

On August 9 I went out two or three miles east of Jackfish to examine locations V4 and 5 with Mr. Pym of Toronto, who had an

interest in them. These locations were surveyed a number of years ago. We walked along the shore of the lake where the rock was exposed and found two small veins running inland from the water's edge. They were two or three feet wide and consisted of pyrites and quartz—the former in excess. They were only exposed for a few feet at the shore, as the rock was covered with a thick layer of earth above high water mark.

Megatherium Mine

Next day I visited the Megatherium mine, about two miles and a half northwest of Jackfish, on Jackfish bay. This property was worked in the spring, but has been closed down all summer. The workings are about a mile and three-quarters from the water. There is a large exposure of quartz 10 or 12 feet wide, but which I am told is traceable only a short distance. It is in the bed of a small creek, and the water had to be dammed and turned off into an artificial ditch which joined the old channel farther down. A shaft had been sunk to a depth of 30 feet, but was full of water at the time of my visit. Boarding camps have been built near the bay.

Locations near Middleton.

Locations near Middleton Station.

On August 11 I went to Middleton with Mr. Duncan McIntyre of Jackfish to examine locations 590, 591 and 592X, owned by Mr. J. E. Newsome of Port Arthur. These locations are two and a half miles north of the railway track, and the same distance west of Middleton. We visited the properties and examined some of the veins, but I had a chance of examining it more thoroughly on the 20th of the month, when I was enabled to see all the veins in company with the original discoverer. The formation is trap and green schist, with a strike of east and west. There are four or five veins besides some felsite dikes and fahlbands. All the veins except one, No. 4, run east and west, while No. 4 is apparently a fissure, as it runs north and south. No. 1 vein, which is farthest south, outcrops in one place as a small mountain of ore about 400 feet long, over 100 feet wide, and rises one to two hundred feet above the ravines around. The material appears to be all quartz on the surface and felsite on the west bluff, which is the boundary at It is heavily charged with pyrites Mr. Finlay D. Grant, the prospector, me that it could be traced for miles only other outcropping, which was a continuation of the same, occurr two or three hundred feet to the e large body It was 25 or 30 feet w as could be determined from wh stripping was done. No. 2 is a vein eight feet wide of nearly solid quar is not exposed very far, but, it is sai traced for a good distance. No. 3 a be one of the best veins. It is trac over half a mile and shows a good wi one place it measures 14 feet of soli and at other places from three or eight or 10 feet. But like all the ve covered with moss and vegetation an seen where this has been stripped little blasting and test pitting has b on this vein, as well as one or two o the property. At the north end of perty is a large fahlband which cro locations. It measures 70 or 80 fee place. Parts of it were very much c No. 4 is apparently a fissure vein. north and south on 592X, and out two places a few hundred yards ap shows a good width where exposed.

These ore bodies are nearly all u large, but it is probable that they wi in most cases to be low grade, and t large stamp mills can treat them succe I saw several other large veins in thi the country, but it is likely that the the same in this respect.

Eberts and Johnson properties.

On our way back we walked into a p about a mile north of the track, wo Messrs. Eberts and John Detroit, who had been t summer, and had ceased operations a f before our visit and gone home. Th a large outcropping of quartz about long and about 70 feet wide, which w exposed and rose above the general few feet. All around the rock was with earth and vegetation, so that trac difficult. In the centre a shaft was probably 20 or 30 feet, but containe water.

Two prospectors have been working all summer on the Slate islands, about seven or eight miles out in lake Superior from Jackfish. I am told that a number of veins have been discovered, but I did not get a chance to visit the place.

On the Slate Islands.

Magnetic Iron Sand.

On the 13th we took the train to Peninsula for the purpose of examining a reputed deposit of magnetic sand in that vicinity. Both east and west of this station along the track for a few miles the formation is sand, blown into dunes which cover hundreds of acres, and extending to the lake shore a short distance away. The black sand in question, we were told, was to be found in a railway cut about four miles east of Peninsula station. We walked out, and, digging about 18 inches in a couple of places where several feet of sand had been removed from the surface, we passed a layer 12 or 14 inches thick of magnetic sand, garnets and white sand, the first being predominant. We were informed that this layer could be found at any point by digging several feet. According to the formation here there might be hundreds of acres of this magnetic sand lying underneath the wind-blown material on the surface, but how the thickness of the layer would vary can only be known by examination. It would however be a deposit which should readily lend itself to treatment by Edison's electro-magnetic process of treating low grade iron ores.

Deposit of Magnetic sand at Peninsula.

The Silver Mines

Two of the old silver mines west of Port Arthur have opened up again; and it appears that others will follow in a short time. These two are the East Silver Mountain and the Badger. Information regarding these mines can be got from the first, second and third Reports of the Bureau of Mines and the Report of the Royal Commission of 1890.

Lake Superior Silver Mines.

I could not conveniently visit both mines on account of the train service, so I went to the East Silver Mountain. Mr. A. M. Wiley of Port Arthur, who is interested in the Badger, informed me that they were not doing any actual mining work at that property yet, but were simply timbering up some of the old drifts which had been pumped out for the purpose of examining the vein with a view to the commencement of mining. A car load of ore weighing 15 tons had been shipped to a smelting works.

The Badger Mine.

No actual mining was going on at the East Silver Mountain either, but a stamp mill had been put in for the purpose of milling the old dump during the winter, while the intention was to commence mining in the spring. This mine is now owned by the Argentite Mining and Reduction Company, with head office at Cedar Rapids, Ohio. It was purchased in March, 1897, and operations commenced two months later. Mr. Richard Sandoe is manager. The only mining work done last summer consists of the stoping out of 70 or 80 tons of ore at the 60-foot level in No. 4 shaft. This was done early in the season. The mill was put in for the purpose of treating the old dump of No. 1 tunnel, which is said to contain about 3,000 tons, and it is believed to average probably 25 oz. per ton. It had only been running a few days off and on at the time of my visit, as all adjustments had not been completed. The machinery consists of a Tremaine steam 2-stamp mill, a Gates feeder, a Brown's 2-compartment hydraulic sizer, two Frue vanners with 6-foot belts, one plain and one corrugated, a 6 horse power marine engine and a 40 horse power boiler. This engine was only temporarily installed while awaiting the fixing of their own engine. The milling machinery is all from the Gates Iron Works. The battery screens are 35-mesh. Experiments were made with 20 and 25-mesh, but they were found to be too coarse. The capacity of the mill is about 12 tons per 24 hours. It is conveniently situated on a slope about 150 yards from the dump at the mouth of the tunnel. The ore is carried in a sleigh, but in the summer when mining commences a tramway will be built over which the loaded cars will be run by gravity.

East Silver Mountain Mine.

I did not go into the tunnel as it was blocked at the entrance, but I got the following notes on the work they intend doing in the spring and the extent of developments from Mr. Sandoe. No. 1 tunnel, which is

now in 1,800 feet, will be driven in through to shaft No. 4, which means 80 or 90 feet more of driving. Then 200 feet more of driving will give 2,600 feet of stoping ground along the vein, with a height of 210 feet. The vein has an average width of about four feet. All ore over 100 oz. of silver to the ton will be shipped, and all under that and over 5 oz. will be milled. Mining and milling will cost about one dollar per ton, and milling the present dump about fifty cents. It is expected that an additional steam mill will be put in in the spring if the present one proves satisfactory.

The water supply is got from Lake on Silver Mountain, about three-qua mile from and 100 feet at mill. There is plenty of w milling purposes. A 1½-inch pipe h laid from the lake to the mill.

Water supply.

There is a force of six men at work

The mine is about a mile from Mountain station on the P. A. D. & road, and about thirty-five miles fr Arthur. A good wagon road leads f station. Plenty of good buildings a property, which were put up at the previous operations.

Mines of Eastern Ontario

By Aaron Slaght, Inspector

I HEREWITH present my Report on the mines situate in that portion of the Province north and east of Sault Ste. Marie, for the year 1897.

The principal mines in this part of Ontario were visited during the year, and the Report also includes a number of properties on which minerals have been discovered and only preliminary development done, showing the broad area over which they extend. From the several larger properties now being worked successfully, it may be inferred that a considerable number of these new discoveries will prove equally remunerative when fully developed.

Western Ontario, British Columbia and the Yukon district have of late attracted a large share of the attention of capitalists, while the rich resources of this extensive mineral region in Eastern Ontario have been relatively overlooked, although they present favorable opportunities to reap a satisfactory return for judicious investments. That large stores of wealth are yet to be won from the mines in this part of the Province can scarcely admit of a doubt, when even a cursory survey is taken of its favorable geological conditions, the class and value of minerals found, and the wide territory over which they extend.

Admirable facilities are offered by railway and water communication, while water power for driving machinery can be utilized in a number of localities, and there is an abundant supply of wood for fuel.

Skilled labor may be secured at reasonable cost, and the most approved kinds of machinery and appliances for mining and treating the ores may be easily and quickly brought in.

Gold Mines

The Comstock gold mine is situated on location WR40 in Rathbun township; it is owned by the Comstock Gold Mining and Development Co., Limited, with capital stock of $600,000. Previous to the transfer of the property work had been done by the former owners by stripping several veins and opening a few test pits and sinking one shaft 16 feet, and also sinking the shaft on which work is now being done to a depth of 30 feet. The present owners acquired possession early in the year, and since March have continued to sink the working shaft until it is now down 102 feet, following the vein for the entire depth at an incline of 60° south. The vein's course is northwest and southeast, and has an average width of 2½ feet, measuring at the bottom nearly four feet. The shaft is timbered down 50 feet to solid rock; the ladder-way was not cased off from the working part of the shaft, nor provided with rests at proper distances, which I directed should be done before extensive mining operations were attempted. At 90 feet from the surface a southeast drift was being commenced which was expected to tap a vein exposed at the surface at the distance of 55 or 60 feet. Several small parallel veins only a few feet apart have been discovered running west of northwest, and it was intended to crosscut from the drift to tap these also. Some stripping on veins has been done, and a couple of test pits have been opened. A portable hoisting engine of 12 h. p. was in use, and the rock was raised in buckets having guides in the shaft. A pulsometer pump was placed at the lake, 170 feet distant, to supply water at the mine. A Sargeant drill had recently come to hand, which would soon be in use.

The Comstock Mine.

The property is favorably located on the border of Boland lake, and the landing for the comfortable little steamer plying on lake Wahnapitæ is within a few rods of the mine. Eleven hands were employed, six of whom were engaged in mining. There is a

comfortable boarding house 18 by 35 feet, containing cook room and sleeping apartments, a blacksmith shop, and barn to accommodate three teams. About 80 cords of wood were on hand. The Inspector's book with necessary entries was left with Mr. H. F. Downing, captain of the mine. I am informed that the mine has been closed down for the winter, but that work will be resumed vigorously in the spring.

The Crystal Mine.

The Crystal gold mine was visited in the last of June, when a total force of 20 men was employed, consisting of 10 miners, two mill men, two blacksmiths, three surface men and a clerk and foreman. Mr. Daniel Morrison of Nova Scotia had charge of the work at both mine and mill.

Extent of the Mining operations.

The main or No. 1 shaft was not being worked at this date, and was partly filled with water. The manager, who had recently taken charge, could not inform me if any greater depth had been made since last inspection, when it was down 100 feet. For description of work done in the shaft, see Report for 1896, p. 268. Work on the No. 2 shaft had been recommenced and it was sunk to the total depth of 37 feet. At 10 feet from the bottom a drift had been run in eastwardly 36 feet and southerly 13 feet, making a total of 49 feet, and ore was being stoped in the drift to supply the mill. The No. 3 shaft, or incline tunnel, was not being worked, and was nearly filled with water. The water had been pumped out of the No. 4 shaft and it was sunk to a total depth of 43 feet, being six feet additional since the last measurement. At the bottom, drifting extended east 23 feet and west 15 feet. Ore was also being stoped out in these drifts to supply the mill. The No. 5 shaft on the east side of the hill was partly filled with water; its depth is said to be 30 feet. I directed that it should be covered to prevent accident, and that all dangerous unused openings should be fenced. At 150 feet southeast of the main shaft a tunnel of four by seven feet had been driven in westerly 33 feet, and at the back end a raise of four by seven feet had been made 15 feet, measuring from the floor of the tunnel.

The foreman informs me at a recent that work has been continuous in the since my visit and consists chiefly of st except that the incline tunnel (No. been driven to the distance of 106 feet that the shaft north of the tunnel (N which was down 43 feet at the date inspection, has been continued to a de 110 feet and sinking continues.

A five-stamp Mill in operation.

A five-stamp mill has been construct the company by the Jenckes Machine pany of Sherbrooke, Que., an vision is made to add othe stamps when required. Th building is situated on the shore of I lake. It is 25 by 60 feet, with ann boiler and engine of 24 by 28 feet. A voir of 1,500 gallons capacity supplie water for the boiler and mill, which is by a pump from the lake. The stam of 850 lb. each, have a 5-inch drop and running at 85 per minute. A crusher Jenckes Machine Company's make capacity of six tons per hour. The ore crushed falls into a bin and is fed by a lenge automatic feeder to the stamps. reduced to pass through a 35-mesh s and passes over an amalgamating pla by 12 feet. The pulp flows over a Fru ner of six by 13 feet, and the tailing carried out into the lake. The mill is substantially built. Beginning with ground floor, the raise to the amalgan floor is 4½ feet, a similar raise to the floor, and a raise of 20 feet to the floor the rock breaker is placed. Good stai lead up to each apartment, with ra where required. The mill was started May 19. At the date of my visit it was run 10 hours per day on a lean quality c obtained chiefly from the development then being carried on. Power is suppli a 60 h. p. boiler and an engine of 35 both of which were in excellent cond About a cord of wood was used per day a supply of from 50 to 75 cords was on The ore is conveyed from the working the upper part of the mill over a horse way. A complete hoisting plant o Jenckes Machine Company has been prov which it is expected will be put in soon.

A saw mill has been built by the company at a few hundred yards from the gold mill, on the shore of lake Matagamasing, where all lumber necessary for the company's use is cut. It is 30 by 90 feet, with boiler of 60 h. p. and engine of 45 h. p. Two lodging houses, an office and store, assay office, private residence, blacksmith shop, ice houses, wharf and boats have been constructed on the location. The powder house is situated across the bay on the shore of the lake, free from all danger. The company conducts a boarding house for accommodation of its employes.

Saw mill and Camp.

Hubbell Mine.

WH50, adjoining the Crystal mine, has been purchased by Mr. Hubbell, who late in the year had work done by stripping some outcropping veins and sinking two shafts of 15 and 25 feet. Work will be resumed in the spring.

The Hubbell Mine.

Last Chance Mine.

The Last Chance mine was idle at the date of my visit; for description see last report of Bureau, p. 269. I have been informed recently that several hands were employed working it during the latter part of the year under the direction of Mr. Chapin, and that its outlook is excellent.

Last Chance Mine.

Gold Cliff Mine.

Gold Cliff mine on Kookagaming lake, is owned by a Toronto syndicate and has been worked during the year. For location and description see last report of the Bureau, p. 57. Mr. Joseph Contre, who had charge of the work, states that he began with a force of six men in January and continued work until the middle of June, driving in a tunnel 182 feet. At about 100 feet from the mouth of the tunnel a vein of five inches was cut, and at 40 feet further another vein was cut two feet in width.

Gold Cliff Mine.

Charlebough Mine.

About six miles south of the Gold Cliff, on the same lake, work has been done on the property known as the Charlebough mine by sinking a shaft 35 feet, but it was idle at the date of my visit. It has recently changed owners and I am informed that work was begun again later in the year with a considerable force, under instructions from the owner, Mr. Ewen McKenzie of Toronto.

Charlebough Mine.

The difficulties of reaching the Wahnapitae mining region hitherto have been greatly lessened by the running of daily stages over the roads to the lake, as well as by the comfortable little steamer Maid of the Mill, which makes daily trips (and oftener if required) to the mines during the season of navigation. The boat is owned by the Wahnapitae Navigation Company, and run by Capt. William Lemoyne. She has a speed of 10 miles per hour, and is registered to carry 20 passengers. The winter roads are usually good.

Improved access to the Wahnapitae region.

Dwyer Mine.

The Dwyer mine is situated on lot six in the fourth concession of Drury township, and embraces 240 acres. It is three miles west of the road leading out from Worthington station on the C. P. R. to the Inez mine, and about six miles by road from the station. The property is owned by the John Dwyer Gold Mining Co. which has a capital stock of $450,000 in shares of $1 each. Some time was spent in going over the property with Mr. E. Robinson, who had charge of the work. There are five veins in all which run parallel with each other in an east and west course. The outcropping of No. 1 vein is near the west boundary of the lot and has been traced for the entire distance across it, varying in width from four to 30 feet. A shaft of eight by nine feet was sunk on this vein to a depth of 32 feet, following a well defined wall and timbered down 20 feet. Quartz taken at 15 feet from the surface assayed $4.60, and at the bottom of the shaft it gave $24. Vein No. 2 is 213 feet south of No. 1, and has been traced about half way across the lot, varying in width from four to 25 feet. From a test shaft of a few feet depth near the west boundary of the lot, and from several places where the vein had

The Dwyer Mine in Drury township.

been exposed by stripping, the ore gave assays of $14 to $26 in gold and over $2 in silver. Vein No. 3 is 25 chains south of No. 2, and has been exposed for a distance of 700 feet, commencing near the west limit of the lot. A test pit of six feet had been sunk in the vein, but no assays had been made of the ore. Vein No. 4 is about equally distant from No. 1 and No. 2 veins, and has been traced 600 feet. Vein No. 5 is south of No. 2 about 350 feet, and has been traced 1,500 feet, showing a width ranging from three to 12 feet. Eight men were employed working the property at the date of my visit.

A small boarding house with sleeping camp has been erected. A tent was being used by the manager, but a comfortable dwelling was in course of construction. There is an abundant supply of timber, and I was told the small streams near by give an ample supply of water. Mr. Robinson writes of late date that work has been discontinued for the winter but will be resumed in the spring. The shaft is now down 40 feet deep, with a free wall and showing a fine body of quartz. Thirteen assays have been made of the ore, nine from the vein worked at the time of my visit showing an average of $14.45, and four from other places which gave an average of $14.42 per ton.

McGown Mine.

The McGown mine is owned by the McGown Gold Mining Co., Limited, of Parry Sound, incorporated under the laws of Ontario, with capital stock of $1,000,000 divided into shares of $1 each. The property consists of lots 146 in A and B concessions, and lot A in B concession in the township of Foley, in all about 169 acres. Since my last report the work consists of sinking a shaft of 30 feet on No. 1 vein, known as shaft No. 1, and from which 15 to 20 tons of excellent ore has been taken. The open cut running east and west, previously reported, has been worked to a limited extent and several tons of ore taken out. One hundred feet west of the shaft an open cut has been made on the vein, showing ore similar to that taken from the shaft. Eight hundred feet easterly of the shaft the vein has been opened by a cutting 10 by 20 feet, which exposes a fine body At 100 feet north of this opening a v crops which has been opened 30 length by six in width. Other veins ing the same course northeaster southwesterly have also been disc Across the small McGown lake, ab yards in width, an outcropping of has been discovered from which so ore has been obtained. The Gove diamond drill was used during the ea of the summer, and the veins tested depths of 40, 80 and 144 feet with tory results.

The McGown Mine in Foley township.

Mr. James Calder, one of the d of the Company, writes me under date: "West of the shaft we have d tunnel into the hill 40 feet, and we a lot of splendid ore on the dump. are working and we shall continue ri It is intended to put up a smelter spring, as we think this is the best treat the ore. A large body of ore taken out along the open cuts, which easily handled."

Mr. Thomas Heys of Toronto has r under date of January 13, 1898, that assayed samples of ore fr mine taken from depths of 30 and 33 feet respectively, with the ing results: At 24 feet, gold $3.60, a trace, and copper $36.85, makin $40.45. At 28 feet, gold $2.40, si cents, and copper $79.64, being a $82.20. At 30 feet, gold $4.80, si cents, and copper 15.92, a total of At 33 feet, gold $14.46, silver $2. copper $79.64, aggregating $96.37. these results the McGown mine migl properly be classed as a copper mi average value of the copper contents four assays being $53 per ton

Assays of the Ore.

Beatty and Wilcox Mine.

Messrs. Beatty and Wilcox have a mine on lot 10 in the fifth conce Cowper. A shaft of 10 by has been put down to a d 25 feet. At 10 feet a of the ore assayed $9.70 in go 70 cents silver, and at a depth of 24 ore gave $34 in gold, the vein b

The Beatty and Wilcox property in Cowper.

entire width of the shaft. The property is a mile from Georgian bay, and is in a direct line six or seven miles southeasterly of Parry Sound.

Belmont Mine.

The Belmont Mine.

The Belmont gold mine, on the east half of lot 20 in the first concession of Belmont, had been been lying idle for some time, but recently it has changed proprietors. The Cardona Exploration Company, Limited, has taken it over after one of the owners had examined it. The company is a private one, composed of wealthy English capitalists, and has been operating mines in England, Scotland, Sweden, Spain and Norway. Mr. David Kerr, who has had charge of works for the company both in Spain and Norway, arrived August 27 from the lattre country to assume the management of this mine. At the time of my visit active measures were taken to commence mining work, as well as for the construction of a 10-stamp mill. An order was given to a Peterborough firm for a substantial plant to work the mine, and negotiations were going on with the same firm for the mill. Mr. Kerr informed me that work would begin at the mine almost immediately and he hoped to have the mill in running condition within a few months.

Bannockburn Mine.

The Bannockburn Mine.

About a year previous to my visit (September 1) the Bannockburn property had been transferred to a Toronto company whose president is Dr. A. W. Hammill of that city. Work had been done by the former owners on lot 28 in the fifth concession of Madoc, at a distance of 300 yards from the mill, by stripping the vein and blasting it open for 700 feet, and sinking four shafts at different points to the respective depths of 26, 30, 45 and 30 feet. In the deepest shaft, at 32 feet from the surface, a drift had been run in 17 feet. New work has been done by the present owners by sinking this shaft 75 feet, and extending and stoping in the drift, as well as by erecting a shaft house and installing a hoist plant of 25 h. p. Underhand stoping has been done along the cut in a number of places, and a considerable quantity of ore taken out. Work had been suspended a short time before my visit, and the shafts were partly filled with water. New work has been done on the lot by sinking a shaft known as the Hungerford, 500 yards west of the mill, to a depth of 30 feet, showing a vein of gold bearing quartz 10 feet in width.

Other exploration work undertaken.

The company has taken options on lots in the county of Hastings covering over 4,000 acres, and on several of these a considerable amount of development has been done. I visited what is known as the St. Joe mine on lot 25 in the fifth concession of Madoc, two miles south of the mill, where three men are employed. The main vein of this mine strikes nearly due east and west. At about 1,000 feet from the Hastings road, and about 40 feet from the edge of a bluff, a shaft has been sunk to a depth of 30 feet, and is all in ore. When this depth had been reached it was decided that the mine could be more advantageously developed by simple quarrying, and the men were set at work to remove the ore on the north face of the shaft from the surface downwards. From this shaft and cut about 300 tons of ore have been taken at an average cost of 30 cents per ton. Three hundred feet east of the shaft another open cut was started late in August, which has been driven southerly into the bluff for about 12 feet. The intention is to continue this drift until the foot wall is reached. From surface indications and measurements I figured that the foot wall is 70 feet distant from the point of entry. This is the narrowest part of the main vein. Assays of the ore made at different times gave $14, $22, $26, $60.66, $38, $42, $30, $3.16 and $2 per ton.

The Bannockburn Mill.

The mill of the Bannockburn mine had been shut down a day or two before my visit, and a clean-up of a 20-ton lot of ore was then being made. Since the description given in a former report the following repairs and additions have been made to the mill plant: A new Blake crusher, with 25-ton capacity in ten hours; new belting and pulleys; double plated mortars for both batteries, of Fraser and Chalmers make; new battery shoes, bosses, dies, and tappets for both batteries,

and new foundations and frames; a Frue vanner with corrugated belt, one of the old ones being repaired, with new foundations for both; nine new plates, 20 by 20 inches; and a Cook amalgamator. The mill has capacity for treating 20 tons of ore daily, and is now used chiefly for testing the ores obtained from the several properties being prospected by its owners. Instructions were given to have the unused shafts and open pits fenced as a precaution against accident, and the manager's attention was called to the requirements of the Mines Act respecting the same. In a recent note the manager informs me that all work at the mine was discontinued soon after my visit for want of capital.

The Deloro Mine.

The properties of the Canadian Goldfields, Limited, consist of lot 9 in the eighth concession of Marmora, 10 in the sixth, the west half of 10 and the north-east quarter of 8 in the ninth; in all, 525 acres. The company is composed of London, Eng., capitalists, and the works are in charge of A. J. G. Swinney, M.E., superintendent. The properties were acquired early in 1896, and operations were commenced in September of the same year. The former owners had worked the mine extensively, and put up a large milling plant which has been lying idle for the last twelve years.

Properties of the Company.

The old workings consisted of a shaft, No. 1, eight by 12 feet, known as the Gatling shaft. It was sunk to the depth of 154 feet at an incline of 55°, being a vertical depth of 127 feet. No additional sinking in this shaft has been done. At 70 feet from the surface on the incline, a level had been run north 119 feet, and south 230 feet. Sixty-six feet north of the Gatling shaft another, known as the Timber shaft, had been sunk to level 1. This shaft has been continued down as a winze, following the vein 79 feet, and connecting levels 1 and 2. At 25 feet north of the shaft a crosscut has been driven in east 38 feet. The north level has been securely timbered, and stoping is now being done. Level 1 south of the shaft has been extended 110 feet, making the total distance south 340 feet where it joins No. 1 level in the Tuttle shaft. At 155 feet south of the Gatling shaft a winze has been sunk 63 feet to level 2 on the incline of the vein. Another winze south of the shaft 260 feet is now being sunk and is down 15 feet. The entire south level has been well timbered, and stoping above and below is now being done. Level 2 is 55 feet from level 1 on the same incline as the shaft. North of the shaft the old works extended 47 feet, and south of it 98 feet. The north drift has been now extended 108 feet, making a total length of 155 feet. At 25 feet north of the shaft a crosscut is being run west and is in 90 feet. Sixty feet of the drift has been timbered and stoping is carried on. To the south the level has been extended 181 feet, making a total of 279 feet, and timbered for the distance of 160 feet; stoping is now being done in it. The total of new work in the Gatling shaft is 400 feet of drifting, 160 feet of winzes, 128 feet of crosscutting, besides the stoping.

Workings of the Mine in the Gatling shaft

The No. 2 or Tuttle shaft, nine by 14 feet, had been sunk by the former owners 62 feet at an angle of 64° west. At that depth a level had been driven north of the shaft 87 feet and a small stope made. Towards the south the level was driven 85 feet. The latter has been extended 62 feet, making the total length 147 feet, and back stoping is now being carried on. At 100 feet south of the shaft a winze is being sunk and is 10 feet down. North of the shaft the level has been extended 57 feet, connecting with level 1 in the Gatling shaft, and back stoping is being done. The total of new work in the Tuttle shaft is 120 feet of levels, 10 feet of winze, and 30 feet of sinking on the shaft, with stoping additional.

Workings in the Tuttle shaft.

The timbering in the mine is substantially and neatly done, and where required chutes are put in for conveniently loading the stoped ore into the tram cars, which are run over well laid iron tram tracks to the shafts for hoisting. Four steam drills are used in the mine, and four pumps are provided to keep it free from water, two being in constant use and two are kept as auxiliaries to be used when required. Two Hines safety boilers of 50 h.p. each supply steam

Machinery in the Mine.

for a double drum hoisting engine of 70 h.p., which serves to hoist at both the Gatling and Tuttle shafts. The skip loads are about 1,800 lb., and about 75 tons of all grade ores are raised daily. A winze hoist is also used for handling timbers and all other materials used in the mine through shaft A, which is 100 feet north of the Tuttle shaft. This shaft also supplies good ventilation in the mine. The poppet-heads, one over each hoisting shaft, are provided with ore bins, each having chutes for handling fine and coarse ore. The skips as raised from the mine automatically dump the ore on the grizzlies, where it is sorted. The first class passes into the bins and is hauled to the mill a distance of a mile and a quarter; the second grade ore is reserved for future use.

Buildings at the Mine.

The buildings in addition to the old mill consist of two poppet-heads, one over each shaft; a boiler and hoisting house (stone) 30 by 70 feet; machine and blacksmith shop, combined with change room for the workmen, 40 by 40 feet; warehouse, 20 by 40 feet; oil house, 12 feet square; powder magazine, 10 feet square; a two-story boarding house with sleeping apartments sufficient to accommodate 40 men; two dwellings for miners and one double dwelling. At the main office are a two-story brick dwelling the lower part used for offices and the upper apartment as sleeping quarters for the single men of the staff; one three-story brick house occupied by the men of the staff with families; five two-story dwellings for miners, now occupied by ten families, and two barns

Condition of the Mine.

The mine manager, Mr. Kirkegaarde, accompanied me throughout the mine and over all outside works, and stated that a force of 76 hands was employed at the mine, 42 on underground work and 34 above ground. In both shafts down to level 1 the part used as ladder or man-way was not properly cased off from the part of the shaft used for hoisting, and I gave directions that the same should be done. The manager stated that this work was being done at nights, when it would not interfere with the hoisting in the day time, and the whole would be completed soon. I directed that proper signals should be placed near the dumping floor of the poppets, to give timely warning to the workmen of the approach of the loaded skips; also that all outside open pits and shafts, of which there were several that were dangerous on account of depth, should be securely fenced, as required by the Mines Act. Otherwise I found the mine in all parts, where work was being done, in a good and safe condition. Apparently due care was observed to protect the workmen from danger and accident. An excellent signal service is adopted in the mine, and proper notices for the same are posted up in conspicuous places. Good provision is also made for handling and storing a day's supply of explosives in the mine, and proper instructions are given for going in and out of the mine by the ladder-ways, which are conveniently and safely arranged.

The new Gold Mill and its method of treating the the Ore.

The Deloro mill is situated a mile west of the mine and 250 yards east of the Marmora station on the Central Ontario Railway. The building has three compartments under one roof. The upper or rock room is 14 by 90 feet, the middle or mill room is 30 by 120 feet, and the lowest or extraction room is 70 by 90 feet. The laboratory building is 45 by 60 feet. Besides these there are an office, storeroom and blacksmith shop under one roof, 20 by 50 feet; mill storeroom, 16 by 20 feet; oil house, 14 by 16 feet; and two family residences.

A good stock of ore is constantly kept in the rockshed for supplying the working mills, in addition to which there is a large reserve stacked on the adjacent ground for future use. The ore first passes through the crushers, of which there are three in the mill, two Blake and one of English make. It is then charged by automatic feeders into the pulverizing machines, of which there are also three, one of German and two of English make. The pulverized material from two of these mills is elevated and passed through screens, and thence is conveyed into a dry separating machine, from which it escapes in two streams into cars, the coarser portion of a specific fineness going into the leaching vats, and the finer or almost impalpable powder being reserved for future treatment. In the third mill the pulverized material is drawn from the mill by a rapidly revolving fan

through a screen into an air-tight chamber, the coarser particles therein falling to the bottom and being automatically delivered into cars for removal, while the fine is delivered outside of the building through the fan and is counted of no commercial value. The leachable product is placed in the vats and treated for the extraction of the gold contained by the Bromo-Cyanide process, the gold being dissolved out and afterwards precipitated and recovered in the ordinary manner. The vats for the extracting purposes are eight in number, two for the preparation or strengthening of the liquors, four for leaching (each of them of 50 tons capacity), and two for the reception of the liquors after leaching prior to the precipitation in the manner indicated. There has been accumulated already a large quantity of the ground ore which has been subjected to the treatment for extraction of gold, which it is proposed later to treat for recovery of the arsenic, itself a valuable by-product.

In addition to a small vertical engine of six h.p. used in the extraction room for working the pumps, seven in number, there is used for the mill one boiler of 50 h.p., an engine of 65 h. p., a duplex pump to fill the storage tank, which is of sufficient capacity to supply the mill for all purposes. The water supply is obtained from a reservoir excavated on the adjacent low ground, from which a channel has been cut to Lily creek at a point about 150 yards distant, insuring a constant head of water.

The primary object being to reduce costs, every possible means has been utilized to this end. A very small force is sufficient to work the breakers and pulverizers, and but few hands are required to conduct the extraction process. Preparations are being made to add to the mill building and to increase the capacity for treatment of the ores. The total force employed by the company averages 150 men.

Exploration of properties by the Company.

Operations have been carried on by the company up to August 31, 1897, on 15 lots in the township of Marmora, five in the township of Lake, and four in Elzevir. The Government diamond drill was being operated on lot 8 in the seventh concession of Marmora in August. One bore was put down 300 feet at a of 45°, and another half a mile dista down 150 feet, the formation as shown cores being hornblende schist and cry limestone.

Craig Mine.

The Craig Mine.

The Craig property comprises the half of lots 4 and 5 in the third con of Tudor, 100 acres. It is ow Messrs. Peter Vanleek, Jame land, David Robbins and the James Estate of Belleville, each holding an joint interest. Gold was discovered property several years ago, and the opened the mine by stripping the 100 feet and sinking two pits of 10 fe The ore was treated at the Banno mill, yielding $4 per ton. The m mained idle for several years, but 1896 a company of Toronto capitalist an option on it for six months, wh property reverted to the original own has been lying idle ever since. Duri period a shaft was sunk 100 feet, s a width of vein at the bottom of eigh Several small test lots of ore were s for treatment, but the result does not to have encouraged further operations

Diamond Mine.

The Diamond Mine.

The Diamond gold mine is a rece covery, and is situated on lot 14 in th concession of Madoc, eight northeast of Madoc village. K. Stewart of Madoc had ta option on the east half of the lot, 13 and was having work done by three men at the date of my visit. On the side of the lot an outcropping quartz v been stripped for the distance of 30 and near the middle of the cutting had been sunk 12 feet, showing a wi vein of five feet, carrying a stringer o inches wide of exceptionally rich mi ore. On the wall numerous specks gold were discovered, and a number specimens of gold have been taken out of exceeding richness was shown to tained the previous week. Captain who accompanied me to the mine, panning of the decomposed materia

a few feet from the surface, which gave a rich showing of free gold. The captain himself has since become financially interested in the property and the shaft has been sunk 20 feet with increased richness of the ore. About 150 yards south of this shaft the vein has been opened to a few feet in depth for 30 yards. Work was being done at this point when I inspected the property on September 2.

Nickel and Copper

Discovery of Nickel, Copper and Cobalt in Foley.

The Boyne mine on lot 35 in the ninth concession of Foley, Parry Sound district, was visited by me on August 12. It is three and a half miles from Parry Sound and one and a half miles from the station of the Ottawa, Arnprior and Parry Sound Railway. The discovery was made about a year ago and a two-thirds interest in the mineral rights was purchased by the Valentyne Mica Mining Company from Mr. Frank LaFex, who retains a one-third interest in the mineral rights. Eight openings have been made on the property, each showing nickel, copper and cobalt. The lode runs east and west with a slight dip to the south. The cap rock has been removed in five places upon the vein and three openings have been sunk of the respective depths of 10, 14 and 20 feet. At the deepest of these the vein shows three feet at the surface and nine at the bottom. The vein also widens in the other two openings from two feet at the surface to five feet at the bottom. The hill rises about 200 feet above the level of the bay, and on the top a large number of outcroppings of ore appear. About $500 has been expended in prospecting, and 90 or 100 tons of ore taken out. Work will be continued and tests made of the value of the ore, of which apparently there is a large body.

Beatty and Wilcox Mine.

Beatty and Wilcox properties.

Messrs. Thomas Wilcox and W. R. Beatty of Parry Sound have secured by lease the mineral rights of the south halves of lots 18, 19, 20, 21 and 22 in the fourth concession of Cowper, and the south halves of lots 10 and 11 in the fifth concession. These properties are situated on Spider Lake bay, an arm of Georgian bay, which affords excellent privilege for dockage. At the shore of the bay there is an outcropping of a lode of copper ore 12 to 15 feet in width, which shows inland for a long distance from 10 to 20 feet in width. Back from the water 20 feet a test pit has been sunk 10 feet, showing the vein to be heavily mineralized. About two chains northeast of the bay another cutting has been made four feet deep, where the ore is equally good. At a further distance of three chains a third opening has been made of five feet in similar ore. Following the vein half a mile another cutting of four feet deep for a considerable length shows very rich ore.

Murray Mine.

The Smelters in Blast.

At the date when the Murray mine was shut down there remained on hand about 6,000 tons of ore which had been roasted by the Vivian Company. During the past year this ore has been treated by Mr. Thomas Travers for Mr. Joseph Wharton of New Jersey. Mr. Travers took charge in August last and completed the work in January of the present year. The old plant was used by Mr. Travers with the addition of two new water-jacketed smelters, and the product in matte has been shipped to the Wharton refining works at Camden, N.J.

Inez Mine.

Trill Mining Company.

The works at the Inez mine, owned by the Trill Mining Company, were shut down at the date of my visit (August 6) with the exception of the roasting heaps, but it was stated that operations would be resumed later on in the season. About 55 hands had been employed in the former part of the year under the direction of Mr. Thomas Travers, manager. The elevated tramway leading out to Worthington station, 4½ miles, had been completed and in use conveying supplies to the mine, and the mine product to the station. It has been usual to make two round trips over it daily, a single horse hauling two cars of two tons each, making four tons each way of a single trip. Seventeen cars of matte averaging 20 tons each have been shipped from Worthington station during the year.

through a screen into an air-tight chamber, the coarser particles therein falling to the bottom and being automatically delivered into cars for removal, while the fine is delivered outside of the building through the fan and is counted of no commercial value. The leachable product is placed in the vats and treated for the extraction of the gold contained by the Bromo-Cyanide process, the gold being dissolved out and afterwards precipitated and recovered in the ordinary manner. The vats for the extracting purposes are eight in number, two for the preparation or strengthening of the liquors, four for leaching (each of them of 50 tons capacity), and two for the reception of the liquors after leaching prior to the precipitation in the manner indicated. There has been accumulated already a large quantity of the ground ore which has been subjected to the treatment for extraction of gold, which it is proposed later to treat for recovery of the arsenic, itself a valuable by-product.

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Operations have been carried on by the company up to August 31, 1897, on 15 lots in the township of Marmora, five in the township of Lake, and four in Elzevir. The Government diamond drill was being operated on lot 8 in the seventh concession of Marmora in August. One bore was put down 300 feet at an angle of 45°, and another half a mile distant was down 150 feet, the formation as shown by the cores being hornblende schist and crystalline limestone.

Craig Mine.

The Craig Mine.

The Craig property comprises the south half of lots 4 and 5 in the third concession of Tudor, 100 acres. It is owned by Messrs. Peter Vanleek, James Maitland, David Robbins and the James Brown Estate of Belleville, each holding an equal joint interest. Gold was discovered on the property several years ago, and the owners opened the mine by stripping the vein for 100 feet and sinking two pits of 10 feet each. The ore was treated at the Bannockburn mill, yielding $4 per ton. The mine remained idle for several years, but late in 1896 a company of Toronto capitalists took an option on it for six months, when the property reverted to the original owners and has been lying idle ever since. During this period a shaft was sunk 100 feet, showing a width of vein at the bottom of eight feet. Several small test lots of ore were shipped for treatment, but the result does not appear to have encouraged further operations.

Diamond Mine.

The Diamond Mine.

The Diamond gold mine is a recent discovery, and is situated on lot 14 in the tenth concession of Madoc, eight miles northeast of Madoc village. D. E. K. Stewart of Madoc had taken an option on the east half of the lot, 138 acres, and was having work done by three or four men at the date of my visit. On the north side of the lot an outcropping quartz vein had been stripped for the distance of 300 feet; and near the middle of the cutting a shaft had been sunk 12 feet, showing a width of vein of five feet, carrying a stringer of a few inches wide of exceptionally rich mispickel ore. On the wall numerous specks of free gold were discovered, and a number of fine specimens of gold have been taken out. One of exceeding richness was shown to me obtained the previous week. Captain O'Neill, who accompanied me to the mine, made a panning of the decomposed material down

a few feet from the surface, which gave a rich show ing of free gold. The captain himself has since become financially interested in the property and the shaft has been sunk 20 feet with increased richness of the ore. About 150 yards south of this shaft the vein has been opened to a few feet in depth for 30 yards. Work was being done at this point when I inspected the property on September 2.

Nickel and Copper

Discovery of Nickel, Copper and Cobalt in Foley.

The Boyne mine on lot 35 in the ninth concession of Foley, Parry Sound district, was visited by me on August 12. It is three and a half miles from Parry Sound and one and a half miles from the station of the Ottawa, Arnprior and Parry Sound Railway. The discovery was made about a year ago and a two-thirds interest in the mineral rights was purchased by the Valentyne Mica Mining Company from Mr. Frank LaFex, who retains a one-third interest in the mineral rights. Eight openings have been made on the property, each showing nickel, copper and cobalt. The lode runs east and west with a slight dip to the south. The cap rock has been removed in five places upon the vein and three openings have been sunk of the respective depths of 10, 14 and 20 feet. At the deepest of these the vein shows three feet at the surface and nine at the bottom. The vein also widens in the other two openings from two feet at the surface to five feet at the bottom. The hill rises about 200 feet above the level of the bay, and on the top a large number of outcroppings of ore appear. About $500 has been expended in prospecting, and 90 or 100 tons of ore taken out. Work will be continued and tests made of the value of the ore, of which apparently there is a large body.

Beatty and Wilcox Mine.

Beatty and Wilcox properties.

Messrs. Thomas Wilcox and W. R. Beatty of Parry Sound have secured by lease the mineral rights of the south halves of lots 18, 19, 20, 21 and 22 in the fourth concession of Cowper, and the south halves of lots 10 and 11 in the fifth concession. These properties are situated on Spider Lake bay, an arm of Georgian bay, which affords excellent privilege for dockage. At the shore of the bay there is an outcropping of a lode of copper ore 12 to 15 feet in width, which shows inland for a long distance from 10 to 20 feet in width. Back from the water 20 feet a test pit has been sunk 10 feet, showing the vein to be heavily mineralized. About two chains northeast of the bay another cutting has been made four feet deep, where the ore is equally good. At a further distance of three chains a third opening has been made of five feet in similar ore. Following the vein half a mile another cutting of four feet deep for a considerable length shows very rich ore.

Murray Mine.

The Smelters in Blast.

At the date when the Murray mine was shut down there remained on hand about 6,000 tons of ore which had been roasted by the Vivian Company. During the past year this ore has been treated by Mr. Thomas Travers for Mr. Joseph Wharton of New Jersey. Mr. Travers took charge in August last and completed the work in January of the present year. The old plant was used by Mr. Travers with the addition of two new water-jacketed smelters, and the product in matte has been shipped to the Wharton refining works at Camden, N.J.

Inez Mine.

Trill Mining Company.

The works at the Inez mine, owned by the Trill Mining Company, were shut down at the date of my visit (August 6) with the exception of the roasting heaps, but it was stated that operations would be resumed later on in the season. About 55 hands had been employed in the former part of the year under the direction of Mr. Thomas Travers, manager. The elevated tramway leading out to Worthington station, 4½ miles, had been completed and in use conveying supplies to the mine, and the mine product to the station. It has been usual to make two round trips over it daily, a single horse hauling two cars of two tons each, making four tons each way of a single trip. Seventeen cars of matte averaging 20 tons each have been shipped from Worthington station during the year.

The large inflow of water into the mine prevented accurate measurements being made at the time of my visit. Mr. Travers however gave results of work since last inspection. In pit No. 1 an extension of the stope had been made 25 feet in length, 10 in width, and a raise of eight feet. This pit is known as level 1. The shaft leading down to level 2. 67 feet, has been properly fitted up, excepting that the ladder-way was not cased off from the hoisting part of the shaft. The skip track leading from level 2 to the rock house was in a safe condition. In level 2 a drift had been run south 60 feet. At the entrance a pillar of six feet was left for support, and beyond it a stope 30 by 40 feet with a raise of 20 feet had been made; also a winze extending up to pit No. 2. There is an additional stope west 35 feet and east 40 feet, making a total length of stope of 190 feet, with an average width of 35 feet and a raise of 50 feet. The lode runs east and west with a dip south of 60 degrees. In level 2 a pump is placed near the bottom and is used once a week to prevent the mine from filling with water during the interim of standing idle. An additional rock breaker of 40 tons capacity had been put in place, and also another boiler with a view of being utilized in refining matte, but so far they have not been in use. Instructions were given to have the large open pits at the recent place of working and an open pit near the roadway, as well as all other open cuts or pits, securely fenced around to protect them from danger.

Operations at the Mine.

During the suspension of work on the Inez mine Mr. R. P. Travers will carry on operations for the Trill Mining Company at several other places. A property three miles west of the Inez, on lot 7 in the first concession of Trill, has been opened and a good wagon road made up to the mine. The deposit, which is large, lies at the base of a cliff which rises about 150 feet. Five hundred tons of good grade ore has been taken out and about $1,200 expended in the development. The ore will be hauled in the winter to the company's smelter for treatment. Mr. Travers has taken an option from William McVittie of Whitefish and another party on lots 3, 4 and 5 in the first concession of Creighton, and work has begun on lot 3, which is eight miles north from Whitefish station, C. P. R. The day previous to my visit he had taken in a 12 h. p. boiler with appendages for running a steam drill. Ten men were sent out to place the machinery and put all in running order, when the force would be increased. About $1,000 had been expended in developing the property by the previous owners.

Other operations of the Company.

Canadian Copper Co's Mines.

The Copper Cliff mine was inspected August 5, when about 100 hands were employed as miners and at outside work, and about 160 tons of ore was mined daily. Work was being done on levels 7, 8, 9, 10 and 11, all of which were examined and the following measurements made: New work in level 7 was made by a stope in the northwest part 78 feet in length, 23 in width and a raise of 50 feet. The workings extend in length to the boundary of the ore. A large space of good ground remained to be stoped near the floor of the level. Two drills are being worked in the level. Since last measurements in level 8 stoping has been extended 60 feet in length with a raise of 32 feet. The total of stoping at date is 260 feet in length, 59 in width and 60 feet raise. Two drills were running on an understope at the floor, and an opening had been made to level 9 of 20 by 30 feet. No addition to the boundary of level 9 has been made since last entry. All ore stoped at date in level 8 passes to this level and is raised therefrom to the rock house. The entire stope in level 10 since last entry in the Inspector's book is new work. The stope is 200 feet in length, 25 in width and 50 feet raise. Three drills were running in this level. The shaft had been sunk an additional 38 feet, making a total of 65 feet between levels 10 and 11 at the same incline, 77½ degrees. The shaft was down 27 feet below the floor of level 11, and a pentice was ready to sink to level 12. A drift extended southerly from the shaft in the 11th level 92 feet to the ore body. At the intersection a stope in the ore was made 71 feet long, 23 wide and a raise of 32 feet. A winze between

Workings in the Copper Cliff Mine.

levels 10 and 11 was required to give ventilation to this part of the mine and for convenience of working. Three drills were in use in this level. Captain Davis writes of recent date: "We have been taking out floors at some points since you were here, but have done no drifting. The shaft has been sunk additional 21 feet, making a total below the floor of level 11 of 48 feet. Also a winze has been sunk 45 feet from level 11, and a winze is being sunk in the northwest end of level 8. Only a small force is being worked on the mine."

A thorough system of scaling and examining the mine as to its safety is adopted. A book is kept at each mine and entries are made at the local offices of the scaling done, stating the names of the persons doing the work, time employed, places in the mine and condition of each place when scaled, and entries are required to be attested by the captain. This precaution is taken in addition to the scaling done by each party of miners as the work proceeds. On the examination of the book I found the following entries made of time occupied: May, 205 days; June, 106 days; July, 79 days. This system has been adopted since the latter part of 1896.

Records of Scaling.

August 9 was occupied in going over the outside works at Copper Cliff At this date three smelters were running, treating about 250 tons of ore in 24 hours. The additional smelter had been started about the middle of July and would be continued until the 1st of October. The auxiliary furnace had been permanently placed and could be run at any time without delay in putting it up. A new horizontal blower had just arrived from Connersville, Indiana, and as the foundations were prepared it would be put in place at once. It is of sufficient capacity to supply one and one-half of the furnaces. The engine connected with it is 16 by 18 inches and about 50 h.p. The capacity of the blower is 67 cubic feet of air for each revolution, and its speed is 90 revolutions per minute. The cost laid down was $2,600. A mill has been introduced for making briquettes by mixing the fine dust from chambers of the furnaces (which carry about 5½ per cent. nickel) with 8 per cent. of lime. By the mixture there is less waste than in the treatment of the dust alone, which has been found impracticable. A large quantity of dust had accumulated, but as the process was found too slow and expensive it was discontinued. Changes may be made to bring it into utility. The matte from the furnace ranges from 37 to 41 per cent. of nickel and copper, being 17 of the former and 23 of the latter. Frequent shipments leave but a small quantity on hand at the smelters. Five additional ore bins had been placed in the rock house. About 400 workmen are employed by the Company in addition to the force on the roast yard.

Work at the Smelting Furnaces.

The roast yard was in a satisfactory condition; no accidents have occurred during the year. Mr. D. L. McKinnon and Partners are the contractors for roasting the ore and delivering it at the smelters. To avoid accidents the company has included the following provisions in the contract, viz: All blasting of the ore heaps is required to be done by the contractor or foreman of the yard, and signals are required to be blown giving timely notice of firing the blast. A sufficient quantity of cold ore must be kept on hand to supply the smelters, and work in removing roast heaps must be confined to three at any one time, so that sufficient time may elapse for roasting and cooling the others. The explosives are required to be safely stored 500 yards distant from the works. There were from 70 to 80 hands employed by the contractors at this date, and about 45,000 tons of ore was in process of roasting. Thirty-two heaps were on the yard, varying from 700 to 4,000 tons each, and requiring from six weeks to six months to finish No roasting is done in winter; the ore however is taken from the heaps to the smelters throughout the entire year. The manager says in a late communication: "Under D. L. McKinnon and his co-partners the work of the roast yard has been performed in a safe, practical and highly satisfactory manner to date."

Work in the Roast Yard.

On the bluff a quarter of a mile northwest of Copper Cliff, at a point designated as Jones mine in last report, considerable amount of work has been done. One shaft has been sunk 32 feet, following

Opening up new ground.

a well defined foot wall three sides being in ore. This is known as McArthur No. 1. From the workings about 400 tons of ore have been taken out. Three men were working in the shaft at the date of my visit, but for most of the season ten men were employed. The ore runs identical with the Copper Cliff in percentage and character, but is perhaps more silicious. The work will be continued to determine the extent of the ore body, and if it proves to be of sufficient quantity a railway track will be laid up to it and the ore taken to the smelters for treatment. A good wagon road is built up to the workings. The captain states that the shaft was down 50 feet at the close of the year. The manager writes on same date: "We have nearly finished the instalment of a small hoisting plant, viz., a small hoisting engine and boiler and a 3-drill compressor and rock house, but can do nothing more until spring. At the other point of working, known as McArthur No. 2, only a limited amount of work has been done since last reported."

Accident at Copper Cliff Mine.

An accident occurred in the ninth level of the Copper Cliff mine on August 9, by the falling of a piece of rock about a foot across and a few inches wide, upon one of the hands, Vick Mickie, a Finlander, aged about twenty years. One of his legs was broken near the ankle and the hip injured. He was in the act of shovelling ore into the tram-car when injured. I had spent the day in examining the outside works at the mine and was about to leave when the report of the accident came in. Immediately I made investigations as to the cause of it, and found that the accident happened at the south end of the level, where an opening had been made through the roof to the eighth level of about 20 by 30 feet. I had gone over this place of working but a few days previous. At the time two drills were working on understopes, and the ore was passing down through the opening to the floor of level 9, from which it was hoisted to the rock house. All was then apparently in a safe condition. The foreman, Mr. Harris, informed me that this region from which the rock fell had been scaled the night previous to the accident by four men, and was considered free from danger. The falling piece of rock was covered with dirt, which would indicate that it had not been newly broken. The circumstances were such that blame could not be attached to the management. The day following I called on the injured man at the hospital, to which he had been removed, and found him recovering from the shock. The physician did not regard his injury as serious.

Workings at the Stobie Mine.

Captain Davies accompanied me through the Stobie mine July 6, at which date 10 hands were employed. About 120 tons of ore were mined daily and sent over by cars to the roast beds near Copper Cliff after being crushed. Additional work since last entry had been done in level 1, or open pit, by a large stope beginning near the floor at the north end and extending 69 feet in length, 46 feet in width, with a slope upwards to within 20 feet of the surface. From this point an opening of six feet square has been made to the surface and a ladder placed leading down to the stope. This opening forms a convenient way for going in and out of the mine and affords free ventilation. The stope has been extended down to level 2, and the stoped ore falls to the floor of this level, whence it is trammed to the shaft and raised to the rock house. In the south part of the open pit an understope has been made to open through to level 2, 53 by 54 feet. In level 2 north of the shaft the stope extends 100 feet in length, 40 in width and raised 60 feet. South of the shaft it is 84 feet in length, 45 in width and 60 feet of raise, making additional since last entry of 84 feet in length, nine in width and 20 in raise. The total extent of stope in the level is 184 feet in length, 45 in width and 60 raise. The shaft has been sunk 65 feet to level 3 at an angle of 65 degrees west. A winze has been opened between the two levels. A stope 23 by 66 feet with 23 feet raise and an incline 69 by 25 feet has been made in the level. The captain informs me in a recent letter that no additional drifting has been done and stoping had been continued in the places of work at the time of my last visit; also that the shaft was put down 20 feet and a winze is being sunk from

New Mill of Sultana Mine. Showing front view of batteries, amalgam plates and mercury traps, p. 47.

New Hoister of Sultana Mine, p. 47.

Keewatin Reduction Works. Front view of two of the batteries showing gyrating amalgam plates, etc. Passage leading to crushing room in background, p. 62.

New gyrating vanner of Keewatin Reduction Works, p. 61

Sawbill shaft and blacksmith's shop, p. 63.

Ore dump at Sawbill Mine, p. 63.

Mouth of the shaft, Sawbill Mine, p. 64.

Gold mill at Sawbill Mine, p. 63.

level. He adds, "We expect to be
)r a large force in the spring." Hoist-
was discontinued on December 24.
ldition had been built to the changing
nd a new cable put on the hoist. The
following is a copy of instructions
given to the captain by the general
manager, regarding the work of
in the mine: "Each foreman in
of the work of scaling will enter in
k provided for the purpose, the day
:e as well as the location and where-
)f all scaling done in each mine; the
)f the men engaged in such work will
inserted. You will then check or O. K.
ıe before it is entered in the yearly
, copy of which will be kept in each
fice. The supply clerk will copy into
ırly book a complete record of the
work done, as well as supply a copy
general office for insertion in the
book, which will be kept there for
reference. The supply clerk after
; will carefully compare to see that
ies made are correct. This will also
against loss of any copy by fire, etc."
ılly examined the books of record and
hat close attention had been given to
ructions. The mine and work outside
)parently in a good condition. In-
ns previously given about fencing the
it, etc., had been properly carried

ıining has been done on the Evans
mine during the past year, but the
ıe. manager states that work may be
l in the spring.

Iron and Iron Mining

in August the Hamilton blast fur-
ıs visited and Mr. Hobson, secretary-
treasurer of the company, accom-
panied me over the works, which
at that date were in full operation,
; 125 tons of ore per day and employ-
hands for day and night shifts. The
vere running in complete order. Only
proportion of the ore used was from
ıadian mines, the principal part being
d from mines on the south shore of
perior.

Mr. John Milne, president of the Hamilton Iron Mining Company, informed me that the company had been formed principally of the parties connected with the furnace, and for the purpose of opening up iron mines in Ontario. Operations had been carried on by opening a property at Desberats, a station five miles west of Bruce Mines, on the Sault Ste. Marie branch of the C.P.R. One mile west of the station a test shaft has been sunk 16 feet and 10 tons of 60 per cent. hematite ore taken out. Another mine three and a half miles west of the station has been opened, where a shaft has been put down 21 feet; at 15 feet the ore ran 50 per cent. and at the bottom 60 per cent. At 500 feet south of the railway track a shaft has been sunk 30 feet in a vein 20 feet wide of lean ore. Another shaft has been sunk 60 or 70 yards north of the track to the depth of 27 feet in similar grade of ore. Work was begun in February last and continued to July 1 with from 15 to 20 men. About 1,000 tons of ore has been taken out and a few tons of it have been brought down to the smelter. Work was suspended pending negotiations for a diamond drill to determine the extent and value of the ore deposits. The company has obtained options on 2,600 acres in the locality, extending to the townships of Coffin and Thompson. A gang of men has been sent out to a property at Little Current, Manatoulin, where a discovery had been made and some work previously done. Mr. Milne states that the surface indications are excellant, and that there is a very large deposit of ore. The workings are only 30 feet from the shore, and by use of a derrick the ore can be loaded from the mine on to a boat.

Hamilton Iron Mining Company.

About a year ago Mr. D. E. K. Stewart and Mr. Charles Miller opened a hematite mine (worked on royalty) on lot 9 in the fourteenth concession of Huntington, about a mile southwest of Madoc village. Three hundred tons of ore were shipped to the Hamilton iron furnace which proved satisfactory as to purity and quality. At the date of my visit, September 3, this property was being worked on option by Mr. G. A. Longnecker of Pennsylvania. One shaft has been sunk 25

Properties in Hastings county.

feet and sinking was being continued. A short distance south another shaft had been sunk in the old pit 45 feet and neatly cribbed to the bottom with two-inch hemlock plank. Five men were employed and a quantity of ore was on hand.

Mica Mines.

A mica property four miles out from Edgington station on the Ottawa, Arnprior and Parry Sound Railway, has been opened; the vein is said to be from four to 16 feet wide and has been followed 400 yards. It is being worked by the Virginia Mining Co. of Toronto, who have recently purchased the property from Messrs. Armstrong & Matchett, the former owners. Several men are working on the property, blasting and taking out mica and constructing buildings at the mine.

Virginia Mining Company.

Mr. J. E. Chown writes under date of October 12 that he had done during the year some mining of mica for Webster & Co. of Ottawa, on the Canton mine in South Burgess. A pit 12 by 20 feet and 30 feet deep was sunk 200 feet south of the old pit, from which fifteen tons of mica were taken, with a good body yet remaining. Mining ceased owing to the inflow of water, but the company claims it will be worked again in the spring. Four test pits were sunk from six to 10 feet in depth on the property.

Canton Mine in South Burgess.

On lot 10 in the eighth concession of Loughboro, Mr. Chown sunk a pit to a depth of 60 feet, eight feet wide and 30 long, from which eight tons were taken, but as the vein was narrowing and the rock becoming very hard, the work was discontinued. A pit was also sunk on lot 6 in the same concession, but with poor results, only about one ton of mica was obtained. Some work was done on lot 7 in the tenth concession, as well as on a property near Buck lake.

Working in Loughboro township.

Actinolite Mines.

Early in September a visit was made to the actinolite property of Mr. Joseph James at Actinolite (formerly Bridgewater), which comprises lot 7 in the first concession of Kaladar and lot 4 in the seventh concession of Elzevir, 30

Properties in Kaladar and Elzevir.

One main opening has been made lot, and the material is quarried by These properties have been worke years past at intervals, and up to date 5,000 and 6,000 tons have been mi taken to the mill. The cost of m stated by Mr. James is less than 25 c ton. Teaming, milling and prepa market make the total cost about $2 About 400 tons of the product is dis annually in various markets, chiefly treal, Winnipeg and the United St duty to the latter country being 20 It is usually sold at $9 to $10 per t lots f.o.b., the Grand Trunk Railwa laid a branch track from Madoc to The prepared actinolite is used exclu roofing and has the appearance o asphalt when laid but is claimed to be to it.

The old Warren Tool Factory have been utilized for milling p which are situated on the mata river, a tributary Moira, with ample water power. T water wheels affording 100 h p. ar which drive one ore breaker, one p of the owner's design and a separat finer part of the material, which is to about 60-mesh, is put into sacks o for the market, and the coarser returned to the pulverizer to be re- A small proportion of waste mica is hand into the pulverizer when in op as a mixture with the actinolite to the bond. The capacity of the 3,000 lb. per hour. About 400 tons material were on hand ready fo ment.

Milling the Rock.

On lots 12 and 13 on the first conc Kaladar an actinolite property ha opened by Mr. A. M. Chisholm York city. Work was begun early year by a few men who opened deposit, but was suspended early tember.

Stone Quarries.

The Gibson stone quarry is situa miles south of the town of Madoc, at ston station on the Belleville and Ma

ay, 1½ miles east of Ivanhoe. The
' is composed of 14 acres in the town-
ship of Huntington. This quarry
had been worked for several years
at intervals by the former own-
ssrs. Broadigan and Co., but has
become the property of William
M.P., who has been working it since
th a considerable force of workmen.
ate of my visit (September 6) there
)loyed 59 stone cutters, 28 quarry
) laborers, five derrick men, three
)ist men, one for boiler and locomo-
'or drills, two for horse powers, four for
ne tool carrier, two water carriers,
enter, four blacksmiths and helpers
loading cars, making a total of 138
'he machinery in use consisted of a
nd locomotive, five derricks, three
)ists, three steam drills, two horse
and four carts.

dge is of large extent and an area of
long and 50 feet wide had been
)ver to a depth in places of 20 feet.
rry can be worked throughout the
'he rock consists of gray limestone,
:tions of which are very hard. The
being shipped to various places for
culverts and other stone work.
it was sent out in the rough, but a
able part was cut on the ground.
)n car loads were shipped daily, the
part going to Montreal for the Vic-
lge. Mr. George W. Blake is the
manager at the quarry.

200 yards south of the Gibson
and just across the Tweed public
road, a property of 28 acres is
owned by the Crookston Point Ann
Co. The company is composed of
lan, S. H. Phippen and A. W. Rob-
l formerly of Belleville. Work had
mmenced by the present company
weeks previous to my visit. A force
)n, which was being daily increased,
loyed, 13 of whom were stone dress-
) other men were engaged in quarry-
general work. A railway side track
ig laid into the quarry. Four car-
stone dressed and prepared according
and specifications were shipped daily
to the new Soulanges canal at Cascade Point,
St. Lawrence river. There was in use at the
quarry a steam power hoist, four horse power
hoists, three derricks and four carts, with
other necessary appliances; blasting was done
only by one competent miner. Crookston is
situated on the railway line and has a popu-
lation of about 300, the men being chiefly
employed in the quarries.

Gypsum Mines.

Work had been suspended on the Paris
plaster mine during the summer, but was
The Paris Mine. resumed about the middle of Novem-
ber with a force of three men, and
at the time of my visit (December 8) from
four to five tons of plaster were taken out
daily. The drift had been well fitted up to
near the place of working, about 300 feet
from the entrance. During the time the
mine had been lying idle a large space of the
roof at the former place of working had
broken down, and the present work consists
partly in removing rock near the breast of the
plaster layer by opening a space sufficiently
wide for a tramway and conveyance for
working. I found the roof to be insecurely
stayed and gave instructions to have several
additional timber supports placed under the
dangerous part, and also to construct a stone
abutment near the point where the work was
being done of not less than 10 feet in length,
and that as work was pushed forward firm
pillars should be left or substantial rock
walls built up to make the mine secure. The
general manager, Mr. J. M. Wheeler, has
informed me that these instructions have been
carried out and the mine made safe.

A force of six to twelve hands is em-
ployed at the mill and office. There is an
increased demand for the products, especially
for calcined plaster. About 12 tons were
ground daily for land purposes, and the
demand has increased materially. Shipments
of alabastine are regularly made to Australia,
where it is favorably received for tinting the
walls and ceilings of houses. The chief market
however is in Canada.

A thousand tons of ore was being shipped in
from the Excelsior mine near Cayuga for calcin-
ing and alabastine. The Paris ore being mixed
with slate is used exclusively as a fertilizer.

The Excelsior mine was visited in September and had just been refitted for work.

The Excelsior Mine.

Mr. John A. Nelles, who has charge, stated that mining of ore would be resumed immediately, and 2,000 tons taken out and shipped to Paris under contract. The plaster is of good quality and is used chiefly for calcining and alabastine. No important changes had been made since last report, and the mine was in a safe and workable condition An area of about one acr layer of plaster has been remov it is estimated that 35 acres are still ing.

Late in the year when I visited tl tindale mine it was lying idle. W been suspended since early in the The Garland mine had not been during the year.

Michipicoton Mining Division

By David G. Boyd, Inspector

I HAVE the honor herewith to present to you my first annual report on the newly created Michipicoton Mining Division.

Under the supervision of the Director of the Bureau of Mines the party left Toronto on September 18, 1897, for Sault Ste. Marie, where the steamer Telegram took us to Michipicoton river, arriving there on the 22nd. There is an Indian settlement a mile up the river, and a deserted Hudson's Bay Company's post, the main building of which we were able to secure and adapt it for the purposes of an office and a dwelling. The office was opened for the transaction of business on the 23rd of September, and was so continued until the close of navigation on the 1st of November, when the Telegram made her last trip.

Toronto to Michipicoton.

During this period there were 133 miner's licenses issued, and 170 notices of mining claims registered and filed in the local office at Michipicoton. The total number of licenses issued relating to this new territory was 250, of which 117 were issued from the Bureau of Mines in Toronto before the office was opened at Michipicoton. The total number of mining claims staked and recorded was 225, of which 55 were registered at the Bureau of Mines in Toronto after the office at Michipicoton had been closed. There are 70 licensees who have not as yet filed any claims. With this exception all the other 250 have filed claims. The amount of money forwarded to the Treasury Department from the office at Michipicoton was $1,242, and the amount received at Toronto was $1,779, making a total of $3,021. Of this amount $2,500 was received for mining licenses, $450 for additional mining claims filed by licensees who had already filed one claim on their license, and the balance of $71 is composed of fees for transfer of claims, affidavits, etc.

Issue of Mining Licenses.

The location of the first discovery of gold, known as Y103, is situate on the south shore of lake Wawa, and in consequence of this the prospectors began examining the surrounding country from that point, with the result that the greater number of claims staked are situate south of lake Wawa. About 25 claims are located north of the lake, 11 on lake Manitouwick, eight on Dog lake, three on Hawk river, and one is located about two miles east of Brulé harbour. Six claims for water lots have been staked in lake Wawa.

Prospecting the Division and staking out Claims.

Traces of gold in this territory were first discovered about the middle of June, 1897, and it was two months later before any considerable number of people went in to investigate the country. For this reason there was little time or opportunity for doing work on their claims. The prospectors came in on one trip of the boat, stayed long enough to locate and register a claim, and went away, there being no place to procure provisions or tools to work. On this account there is nothing worthy of being reported as to the progress made in development.

During the present winter a gang of eight men are developing two claims of the Great Northern Mining Co., namely the Jubilee and Dandy. Three men are also engaged in stripping veins and thoroughly prospecting properties held by the Gold Fields Co. of Michipicoton, Limited. These are the only operations that are going on during this winter, so far as I have learned.

Development work in progress.

Appended is a list of the persons to whom licenses have been issued during the year, together with their place of residence and the number of the mining claim (if any) staked out by each licensee. Where not otherwise indicated, the licensees are residents of Ontario.

List of Licensees in 1897.

Name.	Residence.	No. of license.	No. of claim.
Aitkin, D. A	Sault Ste. Marie, Mich	86	*84
Allan, R. J	Chapleau	48	
Allan, W. G	Perth	99	175
Amey, C. I	New Edinburgh	43	*85, 87
Andrews, C	Sault Ste. Marie, Mich	317	*121
Andrews, O. L	Binghampton, N. Y.	347	114
André, George	Michipicoten Post	370	73
Armstrong, W. J	Guelph	114	201
Bailey, C. W	Oscoda, Mich	310	13
Ball, H. G	Niagara	414	127
Baluss, H	Wayne, Mich	301	40
Bannerman, A	Ottawa	66	
Barnhisel, J. C	Sault Ste. Marie, Mich	363	95
Barnum, H	Binghampton, N. Y	413	130
Barton, J	Sault Ste. Marie, Mich	434	188
Barton, S	Sault Ste. Marie	410	
Belleau, E	Levis, Que	104	
Belleau, I. N	"	103	
Bennett, G. N	Melbourne	60	
Biron, S	Sault Ste. Marie	314	*189, 207
Bishop, T	"	341	*22
Blackinton, A. D	Detour, Mich	374	148
Black, J. F	Montreal, Que	422	166, 167
Blakely, E. A	Missanabie	91	
Blue, W	Toronto	390	
Bonewell, G. F	Chapleau	46	
Bork, W. H	Toledo, Ohio	334	
Bossineau, J	Sault Ste. Marie	315	
Boyd, J. C	"	365	93, 208, 209
Boyd, W. S	"	398	*106
Boyer, B	"	357	68
Brown, A	"	346	113
Burt, T	Chapleau	45	
Bush, C	Hamilton	113	
Caley, C. W	Sault Ste. Marie, Mich	96	
Campbell, A. D	Sudbury	24	
Campbell, K	London, England	94	96
Carrick, F. J	Sudbury	23	132
Carrier, S. N	Levis, Que	105	
Chapin, F. B	Sudbury	95	186
Chapman, W. C	Akron, Ohio	1	
Charles, J. L	Perth	84	196
Charles, J. H	"	98	198
Chisholm, G	Sault Ste. Marie	381	131
Chittenden, S	Paterson, N. J	419b	154, *215, *217, 219, 22
Clarke, C. G	Sault Ste. Marie, Mich	356	67
Clark, D	Palmerston	396	80
Clark, E. D	Guelph	107	200
Clark, H	St. Paul, Minn	400	119
Comerford, J	Municing, Mich	405	143
Conly, L. H	Sault Ste. Marie, Mich	57	*63
Cook, C	Sault Ste. Marie	65	192, 193, 194
Cowen, F. M	Flushing, Ohio	391	90
Cracknell, A. B	Sault Ste. Marie, Mich	40	*61

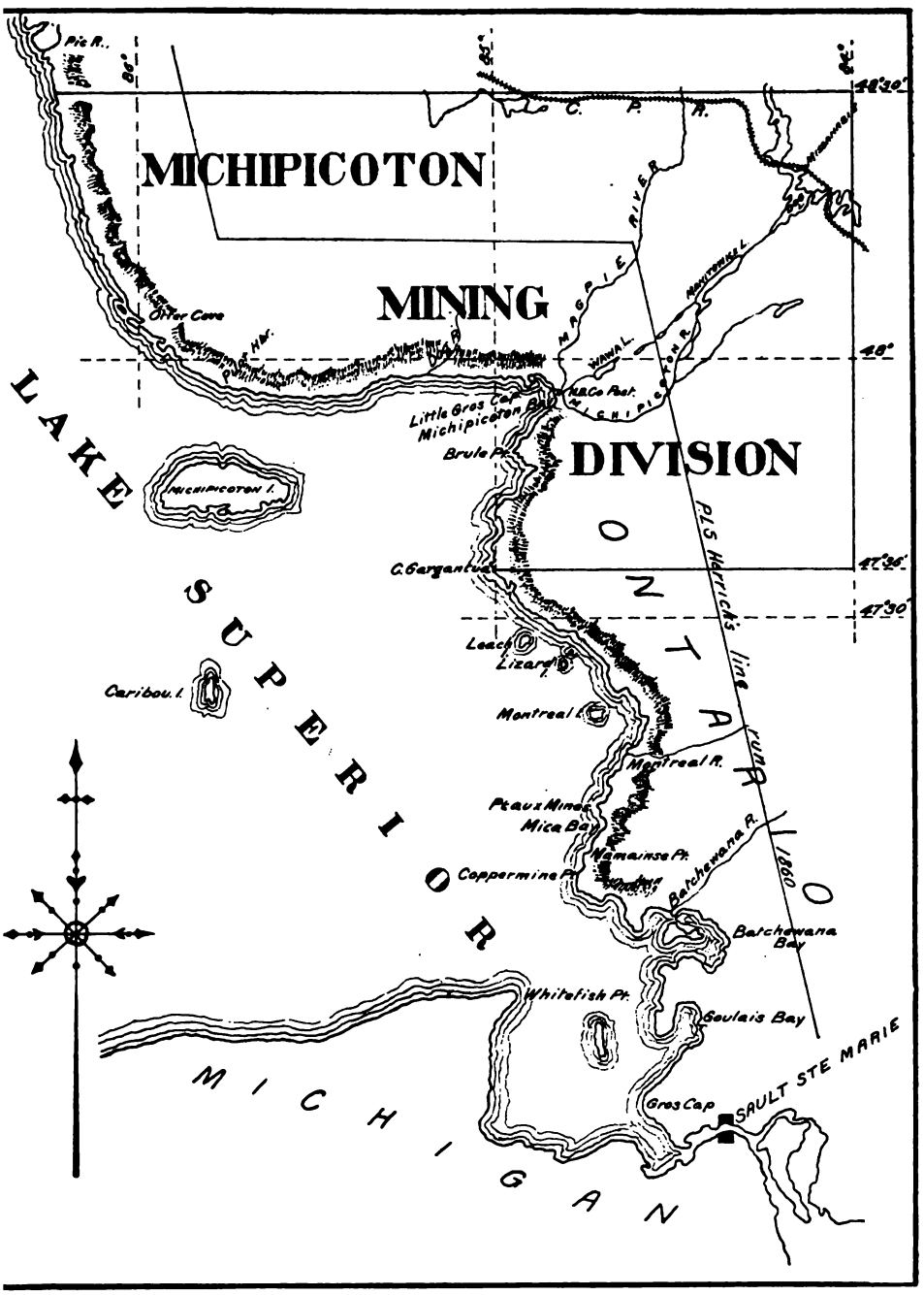
Name.	Residence.	No. of license.	No. of claim.
Cross, A. D	Port Colborne	8	
Currie, J. A	Toronto	6	8, 12, 30
Cusack, M	Marquette, Mich	411	111
Davidson, J	Ottawa	79	*45, *124
Dentinger, A	Gatesville, Mich	354	31
Dion, J. J. T	Fall River, Mass	321	*50
Dillon, J	Schreiber	14	
Dingnam, N. J	Palmerston	395	78, 79
Doherty, R. J	Toronto	320	*138
Douglas, S	Sault Ste. Marie	108	228
Douglas, P	London, Eng	361	*108, 204, 205, 227
Dowrie, R	Guelph	331	23
Dreany, A	North Bay	359	*107, 210
Dreany, H	"	382	211
Drew, T. F	Paterson, New Jersey	420	*185, *216, *218, 220, 221, 224, 225
Dubray, A	Montreal	87	
Dumond, S	Sault Ste. Marie, Mich	34	19
Dunn, J	Sault Ste. Marie	408	
Eccles, G. H	Sault Ste. Marie, Mich	311	100, 141
Edey, M. C	Ottawa	75	*46
Edey, R. W	"	77	83
Emory, W. J. H	Toronto	70	
Evans, A	Melbourne	82	135
Falconer, P	Sault Ste. Marie	307	*15
Fenton, F. A	Toronto	4	11, 48
Ferguson, C. M	North Bay	64	
Ferguson, R. G	Sault Ste. Marie, Mich	37	*41, *59
Fitzgerald, T	Pine City, Minn	304	115
Flanagan, J	Sault Ste. Marie	329	*103
Foster, A. B	Sault Ste. Marie, Mich	406	145
Fournier, H. A	Missanabie	32	
Frank, J. G	Brantford	17	
Ganley, James	Sault Ste. Marie	28	*206
Ganley, Joseph	"	53	156
Ganley, T	"	319	155
Gardiner, F	Toronto	338	*123
Gemmell, L. J	Perth	85	197
Gillies, J	Carleton Place	92	176
Gillies, H	"	93	177
Gilmore, S. M	Toledo, Ohio	333	54, 199
Gobbins, J. P	Missanabie	50	
Goetz, A	Sault Ste. Marie, Mich	55	36
Goetz, Mrs. A	"	56	35
Goetz, Annie	Detour, Mich	419a	*184
Goetz, G	"	362	33
Goetz, J	"	318	34
Goetz, P	Sault Ste. Marie, Mich	54	32
Goetz, A	Gatesville, Mich	387	69
Goold, A. H. W	Brantford	18	
Gordon, G. S	Missanabie	51	
Gould, W. E	Onondaga, Mich	372	159
Graham, W. M	Sault Ste. Marie	308	16
Grant, F. D	Port Arthur	72	
Gray, S. H	Rockland, N.Y	431	153

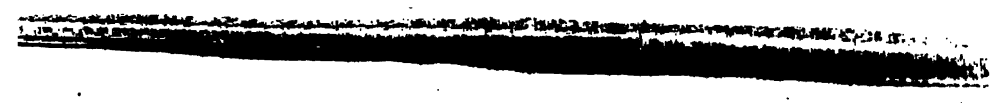
Name.	Residence.	No. of license.	No. of claim.
Halliday, J.	Chapleau	74	
Hamilton, W. E.	Montreal	120	
Harvey, A	Chapleau	26	
Hobson, A. B.	Flushing, Ohio	392	91
Hobson, W. C	Bartlett, Ohio	350	76
Hodgson, W. F.	Algonac, Mich	302	39
Hogg, J.	Guelph	339	
Holding, R.	Chapleau	25	
Hopkins, H. J.	Pleasantville, Penn	378	99
Horovsky, E	Duquesne, Penn	313	2
Hotchkiss, F. W	Sault Ste. Marie	30	77
Howland, O. H.	Cuyahoga Falls, Ohio	9	
Hudson, A.	Ottawa	69	
Hursley, C. F.	Sault Ste. Marie, Mich	407	*120
Hursley, Jay	" " "	35	43, *58
Husson, W.	Guelph	106	202, *203
Hyman, J. W.	London	340	21, 25
Jelley, J	Webbwood	412	*126
Johnson, T.	North Bay	360	140, 214
Johnston, Jessie A	Chicago	401	117
Johnston, J. F	Chapleau	44	
Johnston, J. H	Sault Ste. Marie	326	*26
Johnston, T.	"	325	27
Jones, A. S	Passaic, New Jersey	428	161
Jones, S. H	Cleveland, Ohio	337	110
Kearns, J. J	Palmerston	397	81
Kenny, T.	Ottawa	67	89
Kimball, Hattie	Sault Ste. Marie	394	
Kimball, W.	"	322	158
Kimball, W., jr.	"	393	157
Kinahor, A.	Michipicoton Post	73	137
Kiteley, T.	Toronto	7	9
Koppel, L	New York, N.Y.	389	
Kronk, J. F	Akron, Ohio	3	
Lauzon, A	Sault Ste. Marie	328	75
Lawlor, J. H.	"	327	88
Layle, D	" Mich	404	*122
Legard, J.	Michipicoton Post	305	109
Legge, C.	Elgin	409	129
Legge, J	Gananoque	345	128
Lemieux, J. B.	Sault Ste Marie, Mich.	316	*55
Lewis, A. E	Milford, Penn.	384	178
Lewis, E.	Summit	97	
Lewis, G	Milford, Penn.	29	1, 179
Lockwood, J	Melbourne	80	134
Lockwood, W. M.	"	81	136
Losie, T.	Sault Ste Marie, Mich.	59	20, *42
Loucks, F. M.	Oil City, Penn.	377	*105
Lunan, W. A.	Thornbury	15	
Many, E. E.	Horton, N.Y.	421	152
Martin, H. G.	Sault Ste. Marie	342	*52
Matheson, A	Nipigon	22	
Michael, G. L	Sault Ste. Marie, Mich	344	65
Miles, D. P.	Huntingdon, Indiana	323	*104
Miller, J. B.	Sault Ste. Marie	349	172, *181, *182

Name.	Residence.	No. of license.	No. of claim.
Moltke, F.	Ottawa	416	
Montague, J. W.	Sault Ste. Marie	388	
Moran, C.	" Mich	418	151
Moran, D.	" "	111	*190
Moran, P.	" "	353	71
Moran, Mrs. P	" "	355	70
Morgan, J	Cleveland, O	430	164
Newsome, J. E.	Port Arthur	71	
O'Brien, W.	Sault Ste. Marie	116	
Macdonald, N	Sault Ste. Marie	385	101
McCoy, G	St. Catharines	90	174
McEwan, A.	Bruce Mines	424	147
McGillivray, W.	Ottawa	76	*44
McGregor, D.	Sault Ste. Marie, Mich	36	*64
McHardy, J. A.	Guelph	332	24
McKay, A. A.	Sault Ste. Marie	388	189, 212, 213
McKenzie, A.	"	309	*51
McKenzie, A.	Kincardine	390	*17
McKimm, U. H	Pembroke	423	168, 169
McLaren, A.	Chapleau	27	
McLaren, J.	Ottawa	68	*86, 88
McTavish, J. W.	Sault Ste. Marie, Mich	41	*56
McVeigh, P	Missanabie	33	
Paris, T.	Sudbury	20	
Parks, G. F.	St. Catharines	89	173
Penny, H. L	Montreal, Que	119	
Perrault, P. E.	Quebec, Que	373	74
Pixley, O. C.	Akron, Ohio	376	72
Price, F. G.	Sault Ste. Marie, Mich	38	*57
Pringle, W. R.	Missanabie	52	
Pruden, A.	Paterson, N.J	427	162
Quigley, G. B.	Bowling Green, Ohio	109	195
Rae, T. C	Biscotasing	117	
Rains, H. D.	Sault Ste. Marie, Mich	42	*62
Rayner, E.	Ottawa	415	*150
Reynolds, F. R.	Patterson, N. J	335	28
Reynolds, C.	"	426	160
Richardson, W	Little Gros Cap, L. Superior	402	118
Richardson, J	" "	403	116
Rielly, J	Sudbury	19	
Rogers, G. H.	Ottawa	78	*47, *125
Ross, S. P.	Missanabie	16	
Roth, F	Cleveland, Ohio	432	
Rouleau, J	Sault Ste. Marie, Mich	366	94
Russell, G. H	Chapleau	47	
Sayers, H	Sault Ste. Marie	358	66, 223
Sayer, J	Garden River	312	8
Schellin, T. J	Michipicoton Post	303	*82
Schuttpelz, H	Cleveland, Ohio	369	146
Scott, A. M	Woodstock	101	
Scranton, G. G.	Sault Ste. Marie, Mich	39	60
Seddon, W. D.	Paterson, N. J	336	37
Seip, G	Allentown, Penn	31	

Name.	Residence.	No of license.	No. of claim.
Shirley, L. H.	Montreal, Que.	88	
Simpson, G. A	Sault Ste. Marie, Mich	379	142, 187
Sinn, C. F	Arnprior	118	
Sliney, J	Ironwood, Mich	13	
Sloat, F. J. J	Akron, Ohio	2	
Smith, R. H	Sault Ste. Marie, Mich	429	144
Suett, W	Missanabie	49	
Supe, O	Sault Ste. Marie, Mich	48	18, *170
Taylor, E. J	Toronto	5	10
Thomas, H	Cuyahoga Falls, Ohio	10	
Tisdale, D	Simcoe	362	92
Tisdale, W. E	"	115	
Tolson, J. H	Melbourne	83	133
Tough, W	Sudbury	21	
Trembley, J	Toledo, Ohio	351	49
Turner, Jemima	Sault Ste. Marie	330	*29
Turner, W	"	306	*14
Turgeon, A	Levis, Que	102	
Totten, J. W	New York, N.Y.	425	163
Urquhart, J	Ironwood, Mich	11	
Urquhart, J. H	Ironbelt "	12	
Ward, L. M	Pleasantville, Penn	324	98
Wardman, P	Saginaw, Mich	110	191
White, Mrs. E. C	Sault Ste. Marie	112	*183
White, F	"	343	*53
White, J	"	348	171, *180
Wight, J	"	433	226
Wilfing, F. J	Sault Ste. Marie, Mich	371	102
Williams, J. D	Ottawa	417	149
Willson, T. L	St. Catharines	100	
Wissüan, M	Michipicoton Post	399	112
Woehler, H. C	Akron, Ohio	375	97
Wylie, W. H	Sault Ste. Marie	435	
Yaunkin, F.	Jackson, Mich	386	

Claims marked with a star (*) are in dispute.


MICHIPICOTON
MINING
DIVISION
ONTARIO
LAKE SUPERIOR
MICHIGAN
Pic R.
C. P. R.
MAGPIE RIVER
Otter Cove
Little Gros Cap
Michipicoten Bay
Brule Pt.
MICHIPICOTON I.
C. Gargantua
Leach
Lizard
Caribou I.
Montreal I.
Montreal R.
Ptaux Mines
Mica Bay
Namainse Pt.
Batchewana R.
Coppermine Pt.
Batchewana Bay
Whitefish Pt.
Goulais Bay
Gros Cap
SAULT STE MARIE
PLS Herrick's line
1860
48°30'
48°
47°30'



Fourth Report on the West Ontario Gold Region

By Dr. A. P. Coleman

Introduction

IN ACCORDANCE with the instructions of Mr. Archibald Blue, Director of the Bureau of Mines, the work of examining and reporting upon the gold mining region of Western Ontario was continued during the past summer. Prof. Arthur B. Willmott of McMaster University was once more appointed assistant, and his services have proved increasingly valuable.

As the present writer had been made one of the secretaries of the Geological Section of the British Association for the Advancement of Science, and the meetings were held in Toronto on August 18 and following days, it was necessary to begin the season's work as early as possible in order to finish before the middle of August, in time to prepare for the meeting.

Accordingly a start was made from Toronto on May 31, accompanying Mr. Blue, who had business in the west. After attending the mining convention then in session at Rat Portage, including visits to various mines of the region, work was begun on the east shore of the Lake of the Woods. All the mines on which any work was being done were examined and a careful survey was made of the Grande Presqu'ile, which had hitherto been unexplored geologically. Here numerous lakes and some small areas of Huronian were mapped. The Camp Bay and Shoal Lake districts were then visited, completing the work on the Lake of the Woods.

On July 2 Wabigoon was reached, and on the following days properties in Van Horne township and on Upper Manitou were examined ; after which we proceeded by canoe up Little Wabigoon river to Long lake and then down Turtle river to Bad Vermilion and Shoal lakes. After examining the mines of this region, we ascended the Seine to Sawbill lake and finally came out at Savanne on July 22.

Returning east Professor Willmott and I parted, dividing up a number of points of interest on the way to Sudbury, which was reached on July 28.

The rest of our time was employed in examining gold and other mines in that district. Lake Wahnapitae and other smaller lakes to the east were traversed, and afterwards the anthraxolite deposits and some nickel and gold properties to the west of Sudbury were visited. On August 8 we returned to Toronto.

During the western part of our work Mr. J. A. Bow, recently appointed Inspector of Mines for the west of the Province, accompanied us ; and the party visited every mine on which work was being done.

My acknowledgments are due to the many prospectors, miners and managers of mines who rendered us valuable aid during the summer, and always received us with great hospitality. As on previous occasions, mention must be made of the admirable maps furnished by the Geological Survey of Canada and of their reports, both indispensable to geologists working in the region.

In the following report Professor Willmott's share in the work will be given in his own words and signed 'W.'

Locations near Rat Portage

Though we arrived at Rat Portage on June 3, the mining convention with its excursions occupied us for the first three days. On June 8 the Scramble mine was examined,

showing considerable advance since the previous year.[1] The most important shaft was

Scramble Mine.

down 60 feet with a dip of 80° to the northwest, and a crosscut of 65 feet had been made at the 50-foot level. As mentioned last year, the mine is on a wide fahlband with some quartz. The strike is N. 15° E., and the width at some points is 35 feet. Near the bottom of the shaft more or less solid quartz comes in, sometimes five feet wide. That the mica schist of the fahlband carries free gold was proved by many pannings, some of them very good.

Close to the fahlband a bed of quartzite or sandstone four feet wide shows itself, very like rock of Couchiching age near Fort Frances. The country rock on the hills for half a mile to the northwest is agglomerate with large rounded pale green masses enclosed in a darker base, sometimes interrupted by rounded ridges of greenstone of the ordinary kind. We found that the boundary of Huronian and Laurentian lies nearly a mile too far to the northwest on Lawson's map, running through the property of the El Diver and Black Sturgeon mines to the outlet of Island lake into Black Sturgeon lake.

Just south of the Huronian boundary and east of the Scramble mine is the Royal

Royal Mine.

mine, in gray granite. Here there are stringers and masses of quartz

An ore in gray granite.

near a schistose band having a strike of N. 65°. Two openings have been made, one to the depth of 23 feet, showing quartz containing some free gold.

The Caribou mine is on a small mass of quartz in Huronian agglomerate. A tiny stamp mill, mainly built of wood in imitation

Caribou Mine.

of larger mills, was put up here by the man in charge some time ago. The stamps consist of a wooden rod shod with an iron plate and weighted with a stone. There were three stamps with three flat granite boulders as mortars in a log trough as mortar box. The mill was worked by a hand crank, and is said to have produced a small amount of gold.

At the Black Sturgeon mine we found a nine by 15-ft. shaft sunk about 30 feet through

Black Sturgeon Mine.

ash-gray boulder clay and a little way into the rock. There was only a small amount of quartz on the dump, and part of it had the look of sandstone, like the band at the Scramble mine, of which this deposit is supposed to be a continuation.

The Princess mine, north of the El Diver, is considered to be on the same fahlband.

Princess Mine.

The rock is green hornblende schist with some dike-like bands of granite. There was not much pyritous schist on the dump, but some rusty, good-looking quartz. The shaft was 24 feet deep, the upper part timbered. We were told that the rock the full width of the shaft assayed from $6 to $12.00 per ton, and that the quartz can be traced across the valley some hundreds of yards. The pyritous schist does not seem as extensive here as at the Scramble, and as it is less micaceous, and a stretch of drift-covered country separates the two mines, there may be some doubt whether it is really the same band of schist. At the time of our visit six men were employed, Mr. John Collins being foreman. Three houses had been put up, cooking and sleeping camps and office, and about two acres cleared. The hilltop near the shaft gives a splendid view of unburnt hilly country with Black Sturgeon lake away below.

The Elsie mine also is regarded as being on a part of the same fahlband. Here

Elsie Mine.

we find green schist charged with pyrites, but not so micaceous as at the Scramble mine. The strike is 55° or 60° at the shaft. Quartz with tourmaline occurs with the schist on the dump. Two other small openings show quartz, one part quartzitic or sandstone like. Nine men were employed here under Mr. L. Adams as foreman, the mine being managed by Mr. Ahn.

The finding of a band of sandstone or quartzite more or less thick at all these properties is

A probably extensive fahlband.

very suggestive of continuity, but the character of the schist charged with pyrites seems to vary from location to location. If they prove to be all on the same fahlband as the Scramble mine, with ore of even a low grade, we shall have a very interesting and important addition to the gold deposits of the region. It is to be hoped that the Scramble mine will soon be thoroughly tested, since the ore it contains may not prove as free milling as the other

[1] Bur. Mines Report, 1896, p. 108.

ores of Western Ontario, and therefore may require different treatment. The amount of ore in this fahlband is so great as to permit of its being worked on a very large and hence economical scale.

Prof. Willmott was instructed to go on horseback to determine the boundaries of Huronian and Laurentian southwest of the Scramble mine, and reports as follows: 'On the road to the Scramble we had failed to see the strip of gneiss laid down on the map, and had certainly found a contact of Huronian and Laurentian rocks along a line about one mile south of that shown on the map. There seemed a probability that the granite area south of Cedar lake was an enclosed boss, and this I found to be the case. Travelling along the railroad track I first reached the granite about a quarter of a mile past mileboard 137, and left it at the same distance beyond board 138. The country on both sides of the track is a swampy plain, with a few protruding hummocks of red granite. To the south of the track the map seems to be correct. To the north I found green schists on the east and north of the swamp which is marked as Cedar lake. The latter, if it exists, is very much smaller than it is represented on the map. W.'

Huronian and Laurentian boundaries.

On Lake of the Woods

Having engaged Thomas McDonald as guide and canoeman and Alfred McCall as cook, we set out on June 10 to visit the mines on Lake of the Woods. Mr. Bow accompanied us, so that a third canoe was necessary, and Mr. Moore came with us as a volunteer.

Big Stone Bay Region.

Entering Big Stone bay, we stopped first at Hay island, where the Hay Island Gold Mining Company had eight men at work with John Kenty as manager. They were sinking a shaft near the shore to strike a vein once reached by a shaft 30 feet deep, now flooded by the permanent raising of the level of the lake. Bedded veins crop out on the hillside inland, rather narrow, but said to pan gold. The quartz from one vein contains many slender prisms of mispickel, one of the few instances of arsenical ore in the region. Camping at the old Winnipeg Consolidated mine, we visited the properties within reach. To expedite matters we divided our party, Professor Willmott taking one set of mines and I another.

Hay Island Mine.

The Medicine Ledge property is at the mouth of Blindfold lake, in reddish coarse granite. A vein of white quartz with some pyrites is said to have been traced 1,800 feet with a strike of N. 10° W. Where work was being done it averaged about six feet wide, but narrowed to two or three feet at the bottom of the shaft, which was 38 feet deep on an incline of about 45°. The hanging wall was well defined, but the foot wall was somewhat broken up. William Kirkley, who had contracted to sink 60 feet on the shaft, had seven men at work.

Medicine Ledge location.

The Master Jack mine, some distance up Blindfold lake, we found shut down and in charge of a prospector who served as guide. The vein of white or reddish quartz runs N. 20° E. through granite, generally red, sometimes greatly decayed along the quartz. The body of quartz as seen in the upper part of the shaft is wide, and 100 yards to the south the prospector showed us that the vein contained two or three feet of good looking quartz. The shaft, almost full of water, was said to be 110 feet deep, with drifts amounting to 100 feet. There are three log houses, a shaft house and stables.

Master Jack Mine.

Professor Willmott reports as follows on the properties of the Dominion Gold Mining and Reduction Company of London, Eng.: 'From the Winnipeg Consolidated I followed a fair road for a mile and a half to the Gold Hill mine. Mr. A. Kingsmill, who was in charge, informed me that this and other properties in the vicinity are owned by the Dominion Gold Mining and Reduction Company of London, England. These properties comprise 1,200 acres, and openings have been made at the Gold Hill, Black Jack, Combination, Golden Slipper, Bull Dog and other veins. At present only five men are employed and these are prospecting the property. There was a probability of the old shaft at the Gold Hill,

Dominion Gold Company's locations.

now down 125 feet, being sunk deeper. At the Black Jack work was carried on during the winter. The shaft was deepened to 90 feet and a drift was lengthened until it is now 150 feet. The stamp mill at the Gold Hill is at present used only for testing. The ore of the Golden Gate, an adjoining property, is also being tested here. The mill is on Islet lake, not on Gold lake as shown on the geological map.

'The Combination vein at the southwest angle of Islet lake was being tested when I visited the property. The quartz is six to 12 inches wide, with a very quartzose green schist on either side, making a band two and a half to four feet thick. It has been stripped for 100 feet and is said to have been traced for a quarter of a mile. The quartz carried no visible gold at the surface, but a few feet down it showed considerable.

'A good road leads west from the Gold Hill to the Golden Gate, a distance of half a mile.

Golden Gate. This property, consisting of 193 acres, is owned by Mr. W. A. Laycock. Fourteen veins have been discovered and test pits sunk on several. The main shaft was being sunk vigorously. At the time of my visit it was 60 feet deep, and a drift had been run for 20 feet. The vein runs about 45° in hornblendic schist, which becomes chloritic towards the bottom of the shaft. Tests made at the Gold Hill stamp mill proved satisfactory. Mr. Laycock described one of his veins as containing native silver and gold, galena, blende, pyrolusite and several copper sulphides. Assays of this gives $4 to $5, mainly silver. W.'

There is a striking difference in appearance between the relatively large and distinct veins with rather glassy quartz in the granite (Laurentian) on Big Stone bay and the narrow, irregular bedded veins and quartzitic stringers in the adjoining green Huronian schists.

Near Andrew Bay.

A good road about three miles long leads northeast from the end of Andrew bay over

Jenny Leigh Mine. fairly dry ground to the Jenny Leigh mine (S140), near the contact between Laurentian and Huronian. The vein appears to be traceable several hundred yards, nearly north and south, with of two or two and a half feet of quar uncovered. Two shafts have been su it, both nearly full of water at the my visit. The northern shaft is granite; the southern appears to be i stone. The quartz in the first shaft as it goes down, but may widen bene water. The quartz on the dump loo The mine is provided with suitable lo made use of by men working on neig properties since the Jenny Leigh l down.

The Stella and Contact mines wer by Prof. Willmott. 'Three-quarters east of the Jenny Leigh is t

Stella and Contact Mines. shaft of the Contact mine property is owned by the Prospecting, Mining and Developi pany of Rat Portage; capital, $1,(President, A. M. Robertson, K The company own in this locality S acres; S86, 40 acres; JO114, 40 JO115, 25 acres; JO116, 160 acr Neil Campbell, the discoverer of the and Stella veins on S87 and S86 resp is managing the development. At t 10 men were employed, but the forc be increased. The main shaft is shore of a lake, on a considerable was sunk 22 feet. The vein is much and the quartz is rather sparingly dis through the schist. Mr. Campbell s he has traced the vein for one and miles, always near the Contact, some it. On the east side of the property is being done on the face of a cliff. of quartz 12 feet in depth is here e but at the bottom of the cut it dis The thickest part is 12 or 15 inches.

On the way to Astron bay Bath isl visited, and it was found that th

Bath Island Mine. Island Mining Company of was carrying on work upo new shaft was being sunk 25 feet we old one, and had reached the dep feet. Owing to a blast having been fi before my arrival, I was unable to g the shaft. Mr. A. C. Burgess, assay camp, stated that the value of the qu improving as the shaft went down, a

· $20 per ton at the bottom; and
›wed me some fair specimens of free
om it.

Camp Bay Region.

nning at Astron bay, several days were
n exploring the almost unknown region
Grande Presqu'ile, an account of which
n hereafter. Leaving that peninsula
rtle portage, various properties on
ish bay and northward of it were visited.
veen Turtle portage and Camp bay, the
ore of Whitefish bay was followed by
Prof. Willmott, who found only
ap Keewatin rocks as far as Last point.

To the north of this as far as Snake
e coast is mainly Laurentian, but at
ttom of nearly every bay Huronian
are found. The east and south shores
ninikie or Grassy bay consist of gneiss,
s an enclosed boss of Laurentian. In
st edition of the Geological map of
f the Woods the changes suggested by
last year have been made, so that the
is shifted west for a mile or two and
the shore as far north as Ells penin-

found no work going on in the imme-
vicinity of Camp bay, and lost some
time in scrambling over rough sur-
veyor's lines before finding the
te mine (S79), where we found 12 men
k under Mr. C. P. Kelpin. The vein,
is in weathered greenstone, has a strike
it 120°, dips slightly to the north and
ular in width, being about a foot wide
of the hill but widening, it is said, to
t at the bottom of the shaft, 35 feet
t the time of our visit. Most of the
from the ore pile had been taken to
ortage. Some handsome gold speci-
were shown us. The region is very
the top of the shaft being 265 feet
d) above Lake of the Woods, while
outh of an adit run in from the
the precipitous hill is about 80 feet

The adit had reached a length of 85
thout yet striking the vein, but pro-
would soon reach it. The camp con-
of three log houses on the shore of a
lake. There was a large amount of
y pine on the location.

The Trojan mine, consisting of locations WA3 and 4 and S77, contains some very large quartz veins. No. 1 vein, running north and south, is in places 12 feet wide. The quartz is white but contains some sulphides, and the adjoining green schist impregnated with sulphides is said to carry gold also. The walls of this vein are not very distinct, and some parts of it have the quartz much mixed with felsite. A parallel vein is about eight feet wide. No. 2 vein, on which most work has been done, also runs north and south, with a dip to the east from the vertical of 21°. There is about two feet of quartz in this vein, which is said to be richer than the larger one; and a shaft had been sunk 54 feet when we were there. Five men were at work on June 23. A hilltop on the property is 495 feet above Lake of the Woods (by aneroid), while the creek on which the camp is placed is only 100, though only a short distance away.

Trojan Mine.

The bold precipitous hills in this neighborhood come the nearest to being mountains of any we have seen in the Lake of the Woods region, and the country is by no means an easy one to traverse.

Regina Bay.

Proceeding to Regina bay, Prof. Willmott examined D264 at the Sioux Narrows, a property owned by the Bertram Engine Co. of Toronto. 'The vein, which runs a little north of west in green schist only a foot away from a mass of granite, is six feet in width of quartz mixed with schist, both well charged with pyrites. It is stated that assays of the ore have yielded from $1.50 to $7.50 per ton. The shaft was down 20 feet, and seven men were at work under W. F. Carlson, while others were expected soon.

Location D264

'A mile east of this are two locations, D224 and D225, owned by T. R. Deacon, F. Caron and DeRosier. On D224 a solid vein of quartz five to seven feet wide has been partially uncovered for one-eighth of a mile. It runs 130° within walls of schist, and sometimes includes a little schist. The quartz is white and shows comparatively little pyrite. The vein crosses a

Locations D224 and 225.

point beyond a small bay on D225, and is said to have been found on an island three-quarters of a mile to the southeast. W.'

Mr. Bow and I visited the Regina mine, which was now under the management of Mr. H. A. Pringle, formerly of West Australia.

Regina Mine.

Not much need be added to last year's general description, except that a small vein, eight inches wide, to the east of the main vein and parallel to it, had been somewhat opened up and had produced some rich ore. Nothing need be said of the mine, which will be described in Mr. Bow's report.

The most interesting change since my last visit was the putting up of a cyanide plant,

The new Cyanide plant.

the first to be installed in our western gold region. In this it was intended to treat both tailings and concentrates. The plant for the treatment of tailings had a capacity of about 600 tons per month, the tailings being conveyed by a centrifugal pump from the mill to the top of the building and drained. It is then treated in vats containing 22 tons, first with a weak cyanide solution (0.08 – 0.1 per cent.) and afterwards with a stronger one (0.2) for six days, after which the sand is washed and discharged into the lake. About a pound of lime is added per ton of tailings to correct acidity ; the consumption of cyanide is 1¼ lb. per ton, and of zinc a quarter of a pound. Two ten-ton vats are used for the concentrates, each taking about five weeks to fill from the product of the vanners. The acidity is corrected as before, and leaching with 0.2 per cent. solution is kept up till the vat is required for a new charge. Very little cyanide is consumed after the first week, and the total consumption is about four pounds per ton. So far 73 per cent. of the gold had been extracted, but it was expected that this could be increased.

In December, 1897, Mr. Pringle informed me that the main shaft was down 374 feet, being then the deepest of any gold mine in the Province, and that the size of the vein was increasing as well as the value of the ore per ton.

The Passage Channel.

On the way up from Regina bay Prof. Willmott examined the island just ea

"Passage" between White

Locations on the Passage Channel.

Long bays and found that i entirely Keewatin schist as r but contains a boss of granite in the c the island having the shape of a) granite appearing also on the west s the Passage. He reports that seve tions have been taken up on the islan the north of the marshy inlet is D24 by Mr. Austen of the H. B. Compa Portage. Two parallel veins of qua been found in the granite, bearir about the general direction of the lin tact. One vein is 12 to 18 inches wi the parallel vein 12 inches wide at a of 20 feet. Fifty feet to the north increases to three feet of quartz wit granite stringers in it. On the w quartz is white and shows little pyrite the shore of the location the granite numerous narrow veins of quart granite itself shows little or no structure. To the southeast of this on Long Point, the greenstone porphyritic crystals of felspar. On shore of the Passage a location was by General Wilkinson for asbesto mineral occurs in narrow seams fillin in the granitic rock close to its cont the Keewatin schists. In the latter pockets of pipestone. Neither miner to be present in workable quantity.

Bald Indian Bay.

On June 29 the Sultana mine wa briefly. The new 30-stamp mill v

Sultana Mine.

under way, matters bein ranged that 20 more stam be readily added, making 50 in a mill was furnished by the Jenckes Co. of Sherbrooke and seemed thoro to the times, several recent impro being introduced. There were six F ners provided with corrugated belts wide. The new shaft house wa arranged to hoist with skips instead ets. The new mill was expected to capacity to treat 80 tons per 24 The new chlorination plant had well, extracting 86 per cent. of t in the concentrates. It is believ

the percentage of extraction would have been higher if the concentrates had not lain so long in the weather. On the whole things were looking very prosperous at the Sultana, whose proprietor certainly deserves his good fortune.

It may not be amiss to add here some information regarding the underwater extension of the Sultana ore body as obtained from Mr. Burley Smith by Professor Willmott. 'Mr. Smith was kind enough to show me a chart on which was represented the results of the bore holes he had put down off Sultana island in the winter of 1896-7. He succeeded in piercing what was held to be the continuation of the Sultana vein in three different bores. The depth of water was 15 feet, and below that lay two feet of clay. One hole put down at an angle of 55° reached the vein at a depth of 56 feet 9 inches. The vein was here 19 feet thick on the angle, including a horse. A second bore was put down at an angle of 70° and reached the vein at a depth of 77 feet, the vein proving to be 24 feet 8 inches thick on this inclination. A vertical bore reached the vein at a depth of 103 feet 6 inches. The vein was here 36 feet thick, including a horse, but this is of course a greater angular measurement. Mr. Smith expected very shortly to begin the placing of a caisson preliminary to the sinking of a shaft. W.'

Diamond drill explorations.

The Grande Presqu'ile.

One of the most peculiar features of that many-armed body of water, Lake of the Woods, is the number of long peninsulas projecting into it, often with such narrow and low connecting links to the mainland that a rise of water of only a few feet would transform them into islands. The largest of these peninsulas, or *presqu'isles* as the early French voyageurs named them, is naturally the Grande Presqu'ile, 30 miles in length from northwest to southeast by 20 in the other direction, with an area of more than 200 square miles. This large body of land, with its own inlets, lakes and streams, is linked with the eastern shore of Lake of the Woods at Turtle portage by a strip of soil and loose stones rising only a few feet above the water and only a few paces across. At high water a comparatively shallow ditch would turn the Grande Presqu'ile into an island.

Description of the Peninsula.

The shores and inlets of the Grande Presqu'ile are fairly well given on the geological map of Lake of the Woods, but its interior is left a blank, and Lawson notes on its surface: 'The interior of this peninsula has not been explored. So far as access has been had to it, it appears to be composed entirely of coarse textured granitoid gneiss. As will be observed, it is surrounded by hornblendio schists and altered traps, which for the most part dip away from it, the geological structure being that of an immense anticlinal dome.'

Lawson's Note.

Under the circumstances, it seemed advisable to put some time upon the exploration of the Grande Presqu'ile, especially as prospectors were beginning to operate on its shores.

In general we found that Lawson's mapping of the contact of Laurentian and Huronian was very correct, and his supposition as to the interior consisting of granitoid gneiss is in the main borne out by our observations. In character the Grande Presqu'ile is very like the neighboring mainland, having many rocky ridges with muskegs and lakes between, forming with their covering of tangled woods a region to be explored only with time and trouble. Even by hard work one could usually advance only about a mile an hour through the woods.

A difficult tract to explore.

Maud Lake to French Portage

It was decided to make a start in the region of Astron bay on the northwest corner of the peninsula, making excursions inland sufficiently far to be fairly sure of the geology; and then to work around the shores with occasional trips inland until the area had been circumnavigated.

Astron bay is a fjord running southward for more than three miles, with rocky shores affording good exposures. At the entrance to the bay one finds the usual eruptive contact of Laurentian and Huronian, after which only granite or

Excursions from Astron bay.

gneiss is to be seen for about a mile and a half. From this on a coarse grained black hornblendic rock, sometimes diorite-porphyrite, shows itself on the west shore practically to the south end of the bay. This rock is penetrated by dikes of flesh-colored granite, and is often very like the more metamorphosed Huronian schist in contact with the Laurentian. It may however be only a more basic variety of Laurentian. A walk three and a half miles inland from the south end of the bay disclosed several small lakes. The rocks observed were gray, fine grained mica schist, or gneiss and some coarse grained diorite. The schist is exactly like the rocks mapped as Couchiching (lower Huronian) on Rainy lake, and it as well as the dark green rock is penetrated by dikes or turned in places to a breccia. The region traversed was rough, with hills rising more than a hundred feet above Lake of the Woods.

Returning, we went southeast to the winter road, finding in that direction only Laurentian gneiss. A long and crooked lake to the west of the road caused us some inconvenience, necessitating a long detour.

Professor Willmott went southward from Astron bay and reports as follows: 'From the south end of Astron bay I followed the old winter road across the Grande Presqu'ile.

On the Winter Road line.

The rocks on both sides I found to be gray gneiss, with very few dikes such as those at the north end of Astron bay. The road follows the beds of three streams. One, small and very short, flows north. The second, crossing the road about the middle, flows northerly for some distance and then crossing the road again turns off to the northwest. The third flows south for about two miles. The whole road lies in a valley which is a continuation of Astron bay. The highest point on the road is about 100 feet above Lake of the Woods. The southern half of the road is very wet, and becomes impassable at the end of three miles. Extensive hay meadows occur in this part. By scrambling along the hills we were able to reach Sabascosing bay. It took two and a half hours to return the four miles without stop and with no baggage, so that the route is useless as a summer portage. W.'

Maud lake was next examined. This is much like Astron bay, except that a fall of about nine feet separates its waters from those of Lake of the Woods. Its shores are entirely of Laurentian after passing the entrance. I travelled south for fully two miles, but finding only granitoid gneiss turned back. The country is very rough, consisting of high hills with steep walls having swampy valleys filled with windfalls between.

Maud lake.

Professor Willmott went eastward and then north and reports thus: 'From the southern extremity of Maud lake we travelled due east for two miles and a half over well burnt hills and fairly dry muskegs to a small lake about three-eighths of a mile in diameter. The rock traversed was entirely gray gneiss, striking 90° or thereabouts. Returning we kept more to the north until we reached a small lake supposed to be one mile east of the centre of Maud lake. After passing to the south of this lake we turned north to get a nearer view of a moose standing on the shore of an adjoining lake. This lake, a little over a mile in length and quite narrow, runs almost north, though with some slight bends. I have named it Mina lake. We skirted the east shore and rounded the northern end where a small stream flows out. Travelling two miles due west, we reached the portage at the foot of Maud lake. The contact here of the Laurentian and Huronian is correctly laid down on the map. Numerous small quartz lenses were seen, but no large veins. The next day we paddled back to the mouth of the stream supposed to come from Mina lake. It ends in a swamp two miles east of the entrance to Maud lake. It is perhaps worthy of note that on the previous day Mr. Bow noticed evidences of living beavers on the headwaters of this stream. W.'

Mina lake.

Beaver inlet, just west of Astron bay, runs southward in a fjord-like way, roughly parallel to the two previously mentioned bodies of water. Its shores are largely formed of the dark green coarsely crystalline rock found to the west of Astron bay, probably much metamorphosed Huronian rock; some portions however look rather more like a dark syenite. A large creek empties into the south end of the inlet, per-

Beaver inlet.

...ps draining one of the lakes previously ...und.

Passing out of Beaver inlet we coasted ...estward and southward to the French or Dry portage, where we had agreed that our three canoes should meet. To our surprise we found no portage ...t the point indicated on the map, but plenty ...f water for canoe navigation. The rocks to ...his point are all Huronian, and some quartz veins are seen on the shore, evidently examined by prospectors, since stripping had been done in some cases, and trees blazed.

Rendezvous at French portage.

There is a house and stable at the so-called portage, but we found no inhabitants except a horse, which seemed glad to see human beings. There is here a small stretch of burnt ground, the first observed on the peninsula.

As the cook's canoe did not arrive at the rendezvous, though sent on by a short route, Professor Willmott and I turned back and camped for the night on an island about two miles north of the portage, after paddling hard against a heavy sea, exploring various channels that might have been taken by mistake. We were fortunate enough to get some bread at a house a short distance below the portage, or we should have gone supperless to bed. At dark we made a bonfire to guide the wanderers, who turned up about ten o'clock. They had lost their way and got into an open reach of the lake, where the high sea had swamped them. Almost the whole of our supplies and kitchen equipment were lost; and Mr. Moore and the cook, Alfred McCall, were in the water more than an hour before the canoe drifted near a small island on which they managed to land, chilled and exhausted.

Swamped on the lake.

This is the first serious mishap that has occurred to a Bureau of Mines party, but fortunately resulted in no loss of life. We were however delayed a couple of days through having to send to Rat Portage for fresh supplies and outfit.

On the Tug Channel.

An excursion was made inland from a point near the French portage by Professor Willmott and myself to determine the position of the Laurentian contact, which was evidently incorrect on the geological map. We found it about a mile inland instead of at the shore, a zone of mixed Huronian and Laurentian extending for at least a quarter of a mile farther, dikes being common. There was a doubt as to whether the coarse-grained dioritic rock met with should be classed as Laurentian or not. It resembles that found at the south end of Astron bay, and may be greatly metamorphosed Huronian. Messrs. J. H. Stewart and A. W. Irish have taken up a location just west of Beaver inlet, where a band of schist somewhat like that of the Scramble mine, but with less sulphides, occurs with a width of 22 feet.

Tracing the Laurentian contact east of French portage.

Continuing on our course around the peninsula we went south down the tug channel taken by steamers between Rat Portage and Rainy river. This channel seems to have been carved out of the Huronian, only remnants of the green schists remaining on the shore. The west side is formed by Falcon island, a large island consisting mainly of Laurentian, but with portions of its border Huronian. On the east shore near a long point, turned to an island by high water, Professor Willmott visited Mack 26 and 27, owned by the Bullion Mining Co., Rat Portage, where there is a vein of white quartz five or six feet wide, striking 160°. The vein has been stripped for about 70 feet, but no further development work done.

In Steamboat channel.

Locations Mack 26 and 27.

Kajagogamog Lake Region.

Turning east and skirting the north shore of McPherson island, we followed a narrow channel into the northern end of Sabascosing bay, passing Indian Reserve No. 30 and the deserted agency. From the head of the narrow marshy end of the bay we followed a small stream inland, finding however only Laurentian gneiss for a mile from shore, when we turned round.

Sabascosing bay.

Learning from a camp of Indians that there was a large lake some distance inland, I engaged two young men as guides and set off with two days' provisions to explore it. The portage from a point on Indian reserve 31A and 35A is about two and a half miles long, much of it

Exploring Kahjagogamog lake.

muskeg and very wet. Some of our party walked in, carrying the supplies and my blankets, the two Indians taking their bark canoe. The Indians and I camped without a tent at the western end of the lake, which they called Kah-ja-go-ga-mog (the "j" soft like "sh"). The mosquitoes made the night camp almost unendurable without proper nettings. The lake, which runs east and west, proved to be about nine miles long, but narrow and crooked, with numerous bays and some islands. Laurentian rocks appear on all the shores except at the west end, where a large creek flows to the south with a considerable fall over a small patch of Huronian. When the west end was reached the Indian, who talked a few words of English, said "No more lake," and we soon returned. The land on the shores of the lake is often muskeg and elsewhere forms low hills, sometimes burnt over.

A day or two later we paddled around the southern shore of the peninsula, past Stairway point to the outlet of the creek flowing from lake Kahjagogamog and followed it up to its head. This stream is called Thompson's creek, and was once used to float down logs from the lake above, there being a dam at the foot of the lake to control the water. There are three rapids with a drop of about nine, 18 and 36 feet respectively as determined by aneroid. The creek is very crooked and flows much of the way through meadows with rank marsh hay. It is however easily navigated by canoe. A rather large tributary comes in from the west about half way down, but this proved too crooked and bush-encumbered for canoeing. There were fresh beaver marks along the creek.

Thompson's creek.

On our way round from the reserve we met F. W. Orde and P. B. Sammons of the Jubilee Mining Company, who had four locations along the shore. One near their shanty runs north and south, pinching and widening, across the strike of Huronian rocks. Where somewhat opened up it was about two and a half feet wide and nearly vertical. The quartz contains little pyrites and has rather a quartzitic look. On the eastern location, which we did not see, there is a vein said to be eight to 12 feet wide, running northeast and southwest.

Jubilee Mining Company's locations.

Stairway Point to Turtle Por

Rounding Stairway point we fou or dikes of granitic rock in black Huronian, with a very low dip, 2 southwest.

Miles bay is a large and confusin water, having a complex shore line a islands, all the shores obser Laurentian. This part of the Woods has evidently been map roughly, since we found that only th features of the shore could be recog

Miles bay.

We camped at an isthmus near of Obabicon bay, and portaging isthmus paddled up the channel into the lake of name. We found to our surprise current was flowing inwards, prob cause of the strong westerly wind Willmott took the southern shore northern. The lake is a fine one, much more correctly mapped than M We found several small patches of along the river and islands toward th ern end of the lake, and an area blende schist and hornblende po about half a mile in diameter on t which projects from the west, cuttin north end of the lake. A litt'e quartz at one point, but is probably not of ance. There are wide stretches of r the northwest corner of the lake.

Obabicon bay and lake.

Professor Willmott reports on the part of Obabicon lake as follows: 'C lake might almost be described as a in the narrow channel connecting Lake of the Woods there is hardly a We crossed to the east side of the l pushed up the marshy inlet for half a the end of navigation. The rock all proved to be gray gneiss. Return coasted south for a mile and a ha crossed to the west shore and coaste outlet. Everywhere gneiss was seen, indication of quartz or other e mineral. Many brilliant orange lili seen dotting these rather barren shore

On the evening of June 22 we Turtle portage, where there are two buildings once occupied as a station. As it was Jubilee celebrated the event by a fine bonfire

Turtle portage.

On Whitefish Bay.

Owing to loss of time through the swamping of one of our canoes early in our survey of the Grande Presqu'ile, we found that it would be necessary to do the latter part of the work in less detail. Knickerbocker inlet, so named for its curious shape on the map, penetrated farthest into the interior, so that it was decided to examine this carefully and not enter all the other indentations of the shore. While I undertook this work Prof. Willmott occupied himself with the eastern shore of Whitefish bay, into which we had passed by crossing Turtle portage. The whole shore so far as seen was of Laurentian gneiss, sometimes porphyritic, and an excursion half a mile to the west of the head of canoe navigation on the inlet showed only the same rock in a region of sharp hills with heavy windfalls. We saw quartz at only one place on the north shore of the southwestern expansion of the inlet, where someone had blazed a prospect. Here there were several irregular quartz veins having a width of about a foot and a half and a strike of 110°. The quartz did not look promising. An assay showed one pennyweight of gold.

Knickerbocker inlet to Cross inlet.

Along the North Shore.

The Laurentian gneiss continues along the shore almost to the end of Cross inlet, on the north side of the peninsula. Here dark gray porphyrite shows itself. It is very schistose, strikes east and west and dips steeply to the north.

Professor Willmott reports as follows: 'The lower end of Cross inlet I found to consist of Laurentian gneiss as laid down on the map. In the extreme northwest bay I found a band of porphyry about six chains wide and striking 70°. At the end of the bay gneiss was found striking about east and west. This I crossed at right angles for 17 minutes (= ¼ mile) to more quartz porphyry (?) striking 70°. This seemed to be the true contact, and does not differ materially from that laid down on the map. At the northwest angle of the "cross" a similar band of porphyry is met, probably a continuation of that crossing the northwest bay. W.'

Owing to the high water we found that the portage at the head of Cross inlet was under water, so that canoes could be pushed through the reeds without difficulty.

In order to test the accuracy of the Huronian contact mapped on the north side of the peninsula we made short excursions inland, Prof. Willmot south of Quartz island and I southwest of of Beacon island. In the latter excursion the Huronian was found to extend, as mapped, about a third of a mile inland from the small bay which we had entered. The rest of the mile traversed was over gneiss having the same strike as the Huronian schist, about east and west. Steep ridges crossed our path in the same direction, but much of the walking was good, being our old brulé. Two small lakes were found by the way.

Contacts south of Quartz and Beacon islands.

Professor Willmott's excursion is described as follows: 'From a bay due south of the east end of Quartz island, which lies south of Cliff island, I made an excursion inland for one mile. The Keewatin schists I found to be one-quarter of a mile in breadth, including in that a zone penetrated by numerous dikes of granite. The gneiss to the south I crossed for three-quarters of a mile. It is quite schistose, striking 70 to 80°. In the schist is a little agglomerate. The strike of the schists is the same as that of the gneiss. No quartz veins were seen. W.'

Hills, Muskegs and Lakes.

As this concludes our exploration of the Grande Presqu'ile, the results may be summed up in a few words. The geology in the main has been correctly mapped by Lawson, though a few small Huronian patches occur in the Laurentian of the interior. The most promising parts of the peninsula from the economic side are the northwest and southwest corners, where veins of quartz occur in or near the Huronian. Numerous lakes were found in the interior, one nine miles in length; and probably several more exist, though no space wider than four miles was left untouched by us.

Geological and topographical features of the Peninsula.

Only a little of the surface has been burnt over, but the best of the timber has been removed for logs or ties. Along the streams

there are numerous hay marshes, some of which are made use of by Indians or others. With the exception of a few Indians, we found only half a dozen inhabitants on the shores of the whole peninsula. Game appears to be plentiful, our party having seen a moose and numerous tracks of caribou, as well as fresh beaver work at two points. Rabbits, grouse and prairie chicken (so-called) are plentiful.

Only a very small portion of the whole area seems fitted for cultivation, and much of that is included in the two Indian reserves on the southwestern shore. The rest of the country is a wilderness of rocky hills, muskegs and lakes.

Shoal Lake Region

On June 26 our work on and near the Grande Presqu'ile was finished, and after crossing the main channel of Lake of the Woods, Portage Bay and Deadman Portage we entered Shoal lake and steered for the mines near Hell Diver bay.

Mr. Bow and I walked across the portage to Bag bay in order to visit the Mikado mine.

Mikado Mine.

As Mr. Bow reports on the extent of the workings, number of men employed, etc., not much need be added to my report of last year.[2] Since then it had been found that the vein passed into the trap (altered diabase) and became much less refractory than it had been near the surface in the granite, very little bismuthinite occurring on the lower levels. Mr. Breidenbach, the manager, considered the ore about 85 per cent. free milling, with only about half of one per cent. of sulphides in the quartz, as compared with 2½ per cent. in ore from the open cut. The average width of the vein was about 4½ feet, with somewhat irregular walls, and the value was estimated at from $20 to $25 per ton.

Two kinds of dikes are to be seen at the mine, felsite and also coarse granite, a felsite dike cutting the vein at the main shaft. A second vein 400 feet east of the main vein and parallel to it, running about N. 35° W., was being opened up. It was only about three or four inches wide at the surface, but rich. It had been sunk upon 70 feet, disclosing four feet of vein matter between the walls, assaying, according to Mr. Breidenbach, on the average an ounce per ton. The vein is in altered diabase just northeast of a dike of granite. A felsite dike must occur somewhere below the surface, since much of this rock was to be seen on the dump. The felsite and also the green "protogine" granite from this shaft are said to be auriferous to a slight degree. At the time of our visit the 20-stamp mill and other buildings were well under way; and since then the mill has been operated, apparently giving quite satisfactory results. The buildings at the Mikado have a character of their own quite different from those of other mining camps of the region. They look solid and business-like.

No work was going on at the adjoining Cornucopia mine on an island in the bay.

Cornucopia Mine.

owing to difficulties among the owners; since, it is said, satisfactorily adjusted. The property consists of the island, D212 and water-lots on each side, D217 on the east, D216 and 229 on the west. The chief work done consists in the stripping of a number of veins and the sinking of a shaft 110 feet deep. The vein sunk upon is 2½ or three feet wide, including some country rock, but very irregular. The ore is said to be rich, a mill run of 23 or 24 tons at the Rat Portage Reduction Works having yielded $60 or $70 per ton.

Professor Willmott reported on the Yum Yum: 'At the Yum Yum mine on Shoal lake

Yum Yum Mine.

the manager, Mr. J. Burley Smith, gave all the information he could. The property, S94, consists of 64 acres owned by the Yum Yum Gold Mining Company of Ottawa. Capital, $1,000,000; president, John Mather; secretary, A. W. Fraser. So far Mr. Smith has confined himself strictly to exploratory work. A number of veins have been found and the more promising tested with a diamond drill. Mr. Smith is a firm believer in the efficiency of the drill for quickly and economically testing a property. Two drills were at work at the time of my visit. Altogether 1,050 feet of boring had been done on this location with a view of testing the continuity of the ore bodies, and of determining the best location for a shaft

[2] Bur. Mines, 1896, pp. 105-6-7.

The majority of the veins run northwest and southeast. No. 3 has been traced for half a mile. On the side of a hill an open cut has been made 60 feet long, 25 deep and six to 10 wide. The well-defined walls are of Keewatin rock. A thin section examined under the microscope by Dr. Coleman proved to be altered diabase. A few yards from the entrance to the cut the drill was at work. A bore hole sunk at an angle of 42° struck the quartz 55 feet below the bottom of the cut. Another bore at an angle of 62° was down 150 feet, but had not pierced through the quartz. The cores are of course carefully assayed. No. 5 vein has been traced northwest for half a mile. It has been uncovered at a number of places and has a width varying from 10 feet downwards. The White Show has been traced northwest for half a mile and stripped much of the way. It occurs in a green schist from which many wide stringers come in, some almost at right angles. The G vein runs northeast and dips to the southwest. Three bores have been made here. The Joe vein runs northwest for one-quarter of a mile. Two pits have been sunk to depths of 17 and 20 feet respectively and two bore holes made. This vein shows considerable free gold. A new find was being stripped at the time of my visit. Free gold associated with tourmaline and magnetite occurred here. Twenty men were at work on the property. The buildings, neat trim log ones, are a sleeping camp, dining room, office, assay office, store and wharf. Mr. Smith expected to begin the sinking of two shafts at once. The ore is to be shipped to the Keewatin Reduction Company's mill.

'The Bullion Mining Company of Rat Portage owns S105, S106 and S107 on Hell Diver bay, Shoal lake. The Monarch vein on S106 bears a little north of east and is enclosed by Keewatin schists. The quartz is about one foot wide and contains little pyrites. Another vein, parallel to this, was discovered shortly before my visit The quartz was about a foot wide and carried considerable free gold. Two pits each 20 feet deep have been sunk on the property and some stripping done. Seven men were at work prospecting the property.

Monarch Mine.

'Across the bay from the Monarch is the Gold Coin, but I found no one at the camp. I was told by my guide that several veins had been found which carried free gold. One that I visited on the top of a hill was a narrow, irregular band in hornblende schists. A shaft had been sunk some distance, but the bottom was not visible on account of water. A wide band exposed on both walls of the shaft consisted of felsite. In it there was about 3 inches of quartz. W.'

Gold Coin Mine

Manitou-Wabigoon Region

Leaving the Lake of the Woods we reached Wabigoon late on July 1. Here Prof. Willmott and I parted for a time. Wabigoon itself is the newest town in the district, and expects to win the trade of the Manitou to the south as well as of various mines nearer by. Two small steamers ply from the village to the north end of the Manitou road, a distance of perhaps 25 miles, including the numerous bends of the creek followed part of the way.

Wabigoon town.

South of Wabigoon Lake.

I took the Wm. Whyte, which made its way south and then eastward up Wabigoon lake, into Little Wabigoon lake, where the course turned about south-southwest to the mouth of Grassy river. From this on navigation is troublesome, especially in Crooked river where at some of the bends the engine must be stopped and the boat pushed round with poles. Even in high water, as it was on July 2, the propellor was frequently clogged with weeds and had to be reversed to disengage them. Many stones have been removed from the channel by the steamboat owners, but some very troublesome ones remained near the head of the creek before entering Minnehaha lake. Here we went aground, but succeeded in getting off again. Later in the summer the dam on Wabigoon river at Dryden, the outlet of Wabigoon lake, was raised by a force employed by the Government so as to keep the water at as high a level as possible, but owing to the dryness of the latter part of the season navigation became very difficult in spite of this improvement.

Steamboat travel on Wabigoon lake.

At the north end of the Government road there was a village of eight or ten tents and two or three shacks, including a store and "hotel." The "town" occupied about five acres, from which the woods had been cut or burnt, and in other directions the woods were unbroken. There was no regular dock, but the small steamer tied up to a precipitous rock which served as a landing place. The Government road, six or seven miles in length, was still under construction, a large force of men being employed in straightening the old trail, grading uneven portions and laying down miles of corduroy over the swampy places. The first wagon passed across the portage while I was there, all stores, etc., having been carried on the back before this time.

The route to Rainy lake.

At the south end of the portage a small village of tents with a log house or two existed, and here a small steamer was under construction to navigate the Manitou. With the completion of this boat, the finishing of a dam south of Pickerel lake to improve navigation on the Manitou chain of lakes, and the making of a road past the rapids between the dam and Manitou sound on Rainy lake, a new and short route to Mine Center will be available. At Wabigoon people expect to see this route in operation next summer, furnishing the quickest and easiest mode of reaching Shoal lake. At Fort Frances and Rat Portage the general opinion seems to be that the route will not compete seriously with the Rainy River route.

Affairs at the north end of lake Manitou were largely at a standstill, waiting in the case of two or three mines until machinery could be brought in over the new road.

Mr. F. W. Guernsey, manager of the Neepawa Gold Mining Co., received me hospitably at their mine near the head of the lake, furnished a canoe and served as guide in my visit to various properties on Upper Manitou. For this I wish to express my thanks; and also to the Hon. Mr. Aylmer for the loan of a canoe on lake Wabigoon.

Owing to the short time at my disposal I was unable to visit the Lower or Big Manitou, and confined my work to the upper lake. Sixteen men were at work on the Jubilee mine (HP 301) under Mr. W. M. Caldwell as superintendent. A shaft was down 62 feet and drifting had been done at the 50-foot level, 30 feet to the north and 38 to the south. The vein is vertical, runs 25° or 30° east of north and seems very continuous. Since my visit I have been informed that this mine has shut down, the ore proving too low grade to be remunerative. This is a disappointment, since last year, before sinking was begun, the vein looked very well. Some quartz taken by myself assays $7 per ton.

Jubilee Mine.

The Victory mine (McA28) of the Neepawa Company is the only other property on which much development has been done on Trafalgar bay at the north end of the lake. Here one shaft has been sunk 46 feet and another 25 feet, while in all 130 feet of drifting has been done. The quartz is at one point 35 feet wide, including some rock. The vein runs about 30°, and is nearly vertical, but has ill defined walls. The ore seems low grade on the whole.

Victory Mine.

The same company is working the Royal Sovereign, HW54 on the Big Manitou, where Niven's 6th meridian touches the lake on the north, and has sunk a shaft 65 feet deep on an incline of 75° to the southeast, the vein, which is wide, running N. 60° E. I was unable to visit this property, which is favorably spoken of.

Royal Sovereign Mine.

The Edna mine, McA29, is supposed to be on an extension of the Victory vein. It is being worked by the Gold Explorer's of Canada, an English company, Mr. Ahn being manager. I found Mr. W. Sharp as foreman in charge of ten men. They had sunk 55 feet with a crosscut of 20 feet. The quartz looked like that of the Victory.

Edna Mine.

The Kishkutena group of locations, including HP366-7-8-9, is owned by Messrs. U. M. Thomas, J. Y. Pratt and B. H. Evans. These locations include bedded veins running 20° in green schist not far from porphyroid. The quartz varies greatly in width, being sometimes 3½ feet wide but generally much narrower, and having usually indistinct walls. Some of the schist is said to pan gold, though not so richas the quartz. A few test pits and

The Kishkutena locations.

tripping represented all the work done time of my visit.

e time was given to Mosher bay, a of water projecting eastwards from Manitou straits, a mile or two south of the exit from the Upper Manitou. The southern projec- this bay has been called Lahay bay. east side of this sheet of water, on 7, there is a gold-bearing dike of por- half way up a steep hill rising from ter. A very interesting schist con- ate, like that near the Ferguson and nines on Shoal lake, crops out on top ill, having a strike of 30° and vertical The pebbles are of all sizes up to a foot neter, and include quartz porphyry, ess porphyry, felsite, green schists and tes of various colors, some very like ne. The pebbles are well rounded. he south end of Lahay bay, near ine lake, on HW170, there is another auriferous dike of porphyry, run- ning 60°, not quite parallel to the of the schists. Cross veins of good quartz carry some free gold. Two ul lakes, named Moonshine and Sun- each about two miles long, empty into over Harrison falls, forming at the visited it a considerable waterpower drop of about 20 feet.

Mosher bay Leullier and Gasse have ip location HW74, near the east end of the bay, where a bedded vein with no regular walls runs near a with a strike of about 65°. The with some rusty schist, all contain- re or less gold, is seven or eight feet id retains the same character to the of a pit 24 feet deep sunk upon it. e pans well and affords some rich ns of free gold. Some ore taken by assays $6 per ton. Other specimens free gold and would go much higher. ul Gasse says that the granite shows bout half a mile to the east of the gs.

6 across the bay shows a thick but r quartz vein in protogine, or a rock closely like it. This location has been named the Big Dick, and is by Messrs. Carroll and Paul.

Six trout from four to ten pounds in weight were caught on this expedition by loading the troll with spikes so as to sink near the bottom. The smaller fish had yellow flesh; the larger ones were salmon tinted.

Owing to lack of time other properties were not visited, though a number are reported to be worthy of attention. The "Swede Boys" are stated to have sunk 40 feet on HP259, an island in Upper Manitou, and to have found ore rich in free gold. Mr. Blum on HW144 is said to have a shaft down 35 or 40 feet; and there are shafts on AL211 and 212, two islands on Manitou straits, said to have produced rich ore.

Other locations on the Manitou lakes.

It is to be hoped, now that a passable wagon road and steamers give easy entrance to the Manitou, some of these properties will be developed and become paying mines. Hitherto access has been difficult in summer, but that drawback will no longer stand in the way. Many rich specimens have come from the Manitou, but up to the present the ore deposits appear to be pockety, so that it is very desirable that some of the larger deposits should be thoroughly tested.

East of Wabigoon Lake.

While I was at the Manitou Prof. Willmott examined other parts of the region. 'Going east from Rat Portage on the evening train to Taché, we put up for the night with the section-men. In the morning we went with them on the hand-car to the end of their section, five miles to the east, and then walked a half mile further where we met the Raleigh section-men. Mr. Joseph Montalhitti, the foreman, told me that there was little prospecting along his section of the road at present. Two and a half miles east of Raleigh a pit had been sunk on a vein in slate (?) for 15 feet. Assays gave $7 in gold. Three and a half miles west of Raleigh and one mile south of the track, a shaft had been sunk at the Black Fox but nothing further was known.

Raleigh.

'Taché, 250 miles east of Winnipeg, is situated on a sand plain surrounded by granite rocks. The Little Wabigoon river crosses the track at this point. It is here quite large enough for canoes, but too

Tache.

rapid. To the south of the pumping plant it has excavated a channel 16 to 20 feet deep in the sand and fine gravel of the plain. To the north of the track the material has been used for ballast. No stratification was observed and no jasper pebbles could be found.

'The granitoid gneiss extends east from Taché to mile-board 254 without change. It is here distinctly gneissic and gray in color. Eastwards it becomes darker and encloses fragments of the green schists. Just east of 254 is a dry muskeg underlaid with well-rounded gravel, in which was found a small piece of jasper.

'The green schists begin a half mile east of mile-board 254, and are said to extend a mile and a half east of Butler, that is for 16 miles. Mr. F. J. Belleau, a prospector met at Taché, is authority for this latter statement. The schists are mostly massive in appearance, and strike about 120°. An occasional dike of felsite was seen in them. A quarter of a mile to the east of the contact there is a narrow band of hornblende gneiss included in the schist. Several gashes of quartz were seen in the vicinity of the contact and close to the railway. One was noticed which was six feet wide and 20 long.

A belt of green schists.

'A number of locations have been taken up along this contact, among them 75P, which surrounds mile-board 254. It consists of 160 acres, owned by Wm. W. Baby and R. W. Jameson, M.P. The quartz occurs in a sheared zone bearing 20°, enclosed in gray gneiss. It has been stripped for about one-eighth of a mile from where it crosses the track to where it passes under a swamp. At many places along the strike there is no quartz, nor even the semblance of a vein. At other points the quartz seems to be at right angles to the strike and is then 18 to 25 feet wide. The quartz is frequently five to 10 feet wide except at these gashes, where it widens out and then fails entirely. The wall also is poorly defined.

Location 75P.

'At the extreme east a very narrow band of green schist is included in the gneiss, and the quartz forms a series of lenses in this and is much narrower than to the west. The quartz on the whole is very white and contains little mineral matter. Mr. Baby informed me that he had assays running from a trace to $56.

'Mr. Brown, a prospector of Taché, i to have found good specimens of fre the south of the station. He was so nothing further was learned of it. west of Taché there is much stra About three miles east of Bois B granitoid gneiss ends, and is fol the Keewatin schists as far as Wabig

Around Dinorwic and Wabig

'Two miles from Dinorwic on the Wabigoon lake is a property know Big Ruby mine, consis two locations, HW125 an making 80 acres in all. The own Thomas Partington, C. T. Brown, Vaughan, A. McLaren and T. H. Sa Mr. Brown was personally superin the development work at the time visit. A short distance from th the main shaft was being sunk in schist and at the time was 30 feet dee vein, which is a bedded one, consi mixture of quartz and slate about six width. Near the bottom of the sh feet of solid quartz was visible on th but this mass may be much wider as not all exposed. There is considerab pyrites in the quartz. Assays ran, it w from $18 to $1,480. Mr. Brown stat an assay of slate and quartz taken righ the shaft yielded $7 to the ton. N shore of the lake a similar bedded v been sunk on for a few feet. The qu here more mixed with schist. Small of native copper are found on the loca

Big Ruby Mine.

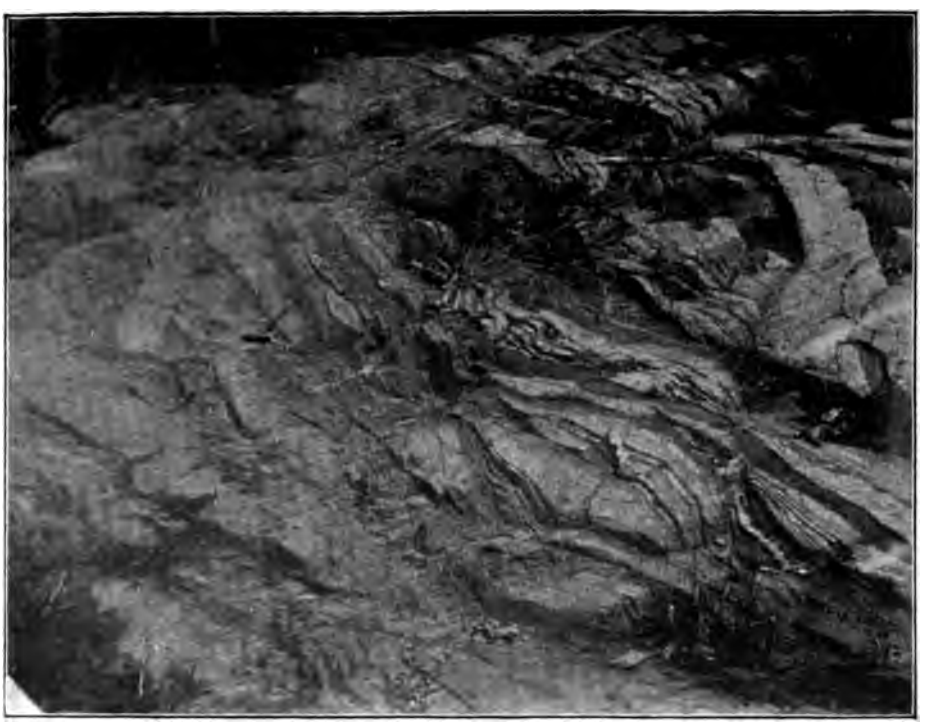
'At Dinorwic Mr. Vaughan, propri the Dinorwic House, stated that the eight or 10 prospecting ca the north, around Sandy and takie lakes. He was intere one property on which they were be to sink. Mr. Mills of the same place specimens of gold-bearing quartz fr same region.

Prospecting north of Dinorwic.

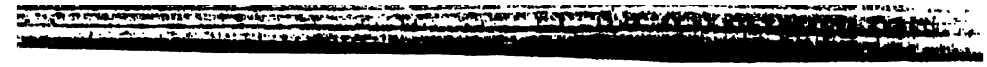
'One mile and a quarter northeast of goon is the Northern Queen mine. trail leads out to it over a pla promising agriculturally. T perty was recently purchased by the Gold Mining Company of Wabigoon. Crawford of Winnipeg is president a

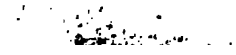
Northern Queen Mine

Kakabeka Falls in 1848. From Agassiz's 'Lake Superior.'



Structure of Gneiss rock at Wahnapitae. Photograph by Willmott.





On Lake Matagamashing.

Crystal stamp mill and old shaft house.

Photographs by Willmott.

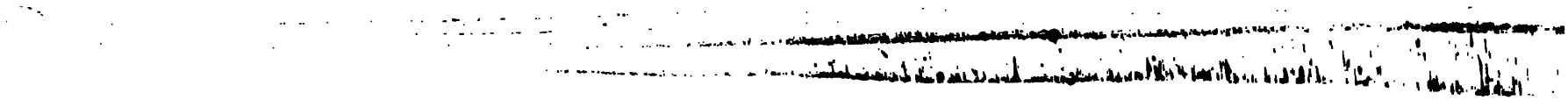
Camp at Crystal Gold Mine. Photograph by Willmott.

Abram's Rapids. Photograph by Parks.

Below Pelican Falls. Photograph by Parks.

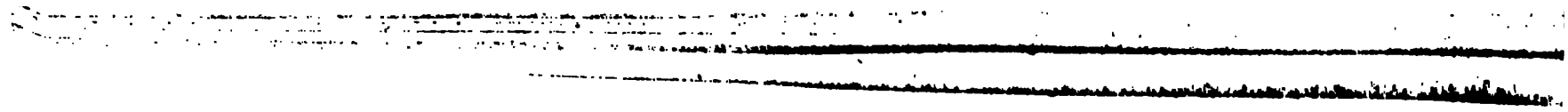
Leaving camp on Pelican Lake. Photograph by Parks.

Sand beach on Vermilion Lake. Photograph by Parks.



River crossed by line above Lake 58. Photograph by Parks.

View from hill above Lake 58. Photograph by Parks.



wan of Brandon vice-president. The
ty at this point consists of four loca-
H W130, 131, 132, 135. At the time
he property was visited the shaft was
water, all work having ceased pending
nsfer. It has been sunk on a fahlband
g east and west in the Keewatin schists.
nd is well oxidized on the surface, and
west of the shaft is easily traced by its
or. On this side little quartz is seen.
shaft a stringer of quartz comes in
the north. Farther to the east the
ty of quartz in the band increases
erably. A pit 200 feet to the
hows a vein of solid quartz four feet
The dump at the main shaft is largely
and mineral matter. Chalcopyrite
ied brown on the surface is by far the
ommon sulphide, but pyrite, marcasite
nonite are also present. Arsenopyrite
to occur also, but I did not find any
e of it. W.'

Van Horne Township.

t of Van Horne township is covered
lacustrine deposits of stratified clay
affording good soil, as may be seen
of in the vicinity of the thriving new
town of Dryden, where the Wabi-
iver has two falls and is crossed by the
ian Pacific railway. The southwest
of the township is rocky however,
ian schists coming to the surface, and
ber of mining locations have been taken
oth in Van Horne and the township of
y just to the west. Rock shows itself
falls in the town itself, where a dike
urmaline granite crossed by quartz
ers rises above the soil at the site of the
ut in to raise the level of the Wabigoon
of waters.

e best mode of access to the mining pro-
s of the township is to go south by
canoe up the winding, sluggish
pro- in river, navigable by small steamers,
orne. then west on an arm of the lake,
nce more south either by canoe on a
w, tortuous creek or on foot by a well
n path through the woods.

lot 10 of the first concession many
veins and stringers of quartz, often
l with a carbonate and tourmaline,
occur in green schist, sometimes running
Little Jumbo Mine. parallel to the strike, at others cross-
ing it. Much of this quartz looks well,
but none of the veins seen are large enough
to be of importance unless quite rich. On
the same lot there is a dike of dark red
felsite, the Little Jumbo, 18 feet wide and
containing some stringers of quartz, running
through a greenish gray agglomerate. Part
of the felsite has been sheared into a dark
spotted schist, and the latter is said to assay
on the average $14 per ton. A specimen
taken by us assayed, to my surprise, 1 oz. per
ton, but may not represent the average rock.
The ordinary felsite seems to carry little or
no gold, and the small amount of quartz to
be seen is not rich. A shaft has been sunk
here to the depth of 55 feet with 20 feet of a
cross cut. It is a very singular ore deposit,
nothing except the small amount of pyrite in
the dark schist suggesting its auriferous
character.

Not far off we saw the Lone Jack mine,
Lone Jack Mine. consisting also of a red felsite dike
with cross stringers of quartz, said
to pan well

Lot 11 in the first concession is owned by
the Grimsby Gold Mining Co., which owns
also five locations on Lake of
Grimsby Gold Mining Company. the Woods and two on Eagle lake,
a few miles west of Van Horne
township. Mr. J. A. Livingstone is manager,
and Mr. John Kerman was acting manager
at the time of our visit. We found here a
shaft 36 feet deep on a vein of quartz
averaging 2½ feet in width, said to
have been traced for half a mile. The
vein runs 12° north of east and dips some-
what to the north. The walls are not very
distinct. Portions of the quartz are heavily
charged with pyrite, and the rock is said to
assay $7.50 per ton on the average, the gold
contents increasing as they go down.

On lot 9 in the second concession, belong-
ing to Mr. R. A. Hutchison, we saw a vein
eight or 10 inches wide, running east and
west and dipping about 45° to the north.
The quartz contains tourmaline and large
amounts of sulphides, pyrite, galena and
zincblende.

The six assays made in the laboratory of
the School of Science from ores obtained by

[illegible] Huronian. [illegible] Further portage (about two miles) [illegible] to the mouth of a respectable [illegible] coming in from the south, up which we [illegible] Long lake. One comes on Little Wahgoon on a little south of east, and this [illegible] changed to a little east of south. The valley of Little Wahgoon, like that of the lake into which it flows, is turbid, but the tributary has beautifully clear water. The shores of the tributary are everywhere canopy and only a few points show rock, all Huronian. About five miles up stream there is a rapid with a fall of about 18 feet

[illegible] Nipi[illegible] [illegible] having [illegible] [illegible] white and re[illegible] [illegible] is Huronian. T[illegible] [illegible] 50 feet [illegible] [illegible] half a mile with a [illegible] feet leads to another [illegible] lake, or rather pond. Here t[illegible] a very bad half mile of portage acr[illegible] height of land between the Wabigo[illegible] Turtle waters. The path is blocke[illegible] much fallen timber. My aneroid reg[illegible] a rise of about 18 feet in crossing the [illegible] of land.

The Turtle River System.

The lake we now entered, belonging Turtle river system, had rather trans[illegible] brown water, and was cut up by sever[illegible] narrow peninsulas in a rather puzzlin[illegible] Near the lower (southern) end an isla[illegible] hill of rock is connected with the [illegible] shore by a long, narrow sand spit on[illegible] we camped. Two miles below this san[illegible] where the lake had narrowed into a c[illegible] with some current, we saw Laurentia

ıe first time, coarse red granitoid
From this on the river, which flows
south for eight or 10 miles, follows
the contact of Laurentian and
n-
on- Huronian, the latter rock show-
ıct. ing on the western shore in
l; though as usual the two rocks
eatly mixed, dikes penetrating the
ian. Near the mouth of a creek there
apid with two feet of a fall, and a
e of two chains. Along this part of
er the shores have been burnt and the
ned trunks are beginning to fall with
nds.

ut a mile below the small rapid there
ronian rock with a strike of 240°.
here is a second rapid with a fall of three
ıd a very rough portage of 2½ chains.
ock on both sides of the river at this
is medium grained flesh-colored
e.

ıg on down the river we pass a small
ınd at last came to a large lake,
goming, but crossing its narrow nor-
end enter the river once more, now
g northwest. Along this portion of
ute there is Laurentian rock containing
a-like mixtures of Huronian frag-
. A mile below the lake there is a
rapid with a fall estimated at six feet,
good portage of six chains, as cut out,
h it might be shortened. The rock
s Laurentian.

river turns west, after two or three
of a north and northwesterly course
lake Pekangoming, and a well formed
e rises seven feet above the water. A
nd a half beyond there are two small
close together with a total fall estim-
t five feet and a portage of two chains
h, on the west bank of the river. Less
a mile of swift water brought us to
er rapid, long and with a fall of about
feet, the portage being about a sixth
nile in length. The rock along this
f the river is Huronian (diorite schist)
intersected with dikes. A terrible
er storm interrupted our afternoon's
for an hour or two, and in consequence
iver rose several inches during the

The water runs very quickly off from
urnt district of bare rocky hills.

A quarter of a mile brought us to another portage with a drop of 36 feet (aneroid) in a sixth of a mile. The fall is magnificent and will some day furnish a fine waterpower. Three-quarters of an hour's paddle intervened before the next portage, of two chains past a pitch of two feet. In ten minutes there was another drop of two feet with a half chain portage. Less than half an hour later there was a two-chain portage past a fall of two feet; and a mile beyond, one of a single chain past a fall of three feet. The next portage was of six chains, and the next a third of a mile of bad trail past two falls, dropping about nine feet in all. By this time we found ourselves well advanced on the Rainy lake sheet of the geological map, on which the portages were marked as well as the height of the falls; which was a great relief, since we had several times been in doubt as to our course, though we had never actually lost it.

We passed Jones lake, a small sheet of water, just touching its eastern end, and proceeded down the river to the beautiful Big Turtle lake, which is five or six miles long but nearly cut in halves by a large island. A mile or two south of the lake there is a short portage, and not far below this a splendid fall, which the geological map puts at 33.8 feet. This will give an admirable waterpower, which can be made available by a cut 300 feet long, partly in rock however.

Jones and Big Turtle lakes.

Much of the rock visible on the shores north of Jones lake, mapped as "hornblende granite gneiss," consists of ordinary Laurentian rock filled with large irregular masses of black or dark gray rock, more or less coarse grained hornblende schist or diorite schist pierced by many dikes and bands of granite, or a gneissoid rock. They are apparently only Keewatin schists more highly metamorphosed than usual.

The scenery on Turtle river up to Big Turtle lake is dreary, consisting mainly of knolls of whitish granite covered with small burnt timber, the valleys largely occupied with lakes or muskegs. The river wanders in an erratic way, often without a definite bed, the whole suggesting a very new hydrography.

Scenery of Turtle river.

Passing through Robinson lake we followed the river south and then southwest between low alluvial banks clothed with green trees and showing few outcrops of rock. We saw nothing of the band of Keewatin shown on the geological map, but might have found it by going inland as far as the hills.

Once more coming to rapids my canoe ran the first one, which was small; but the other canoe, steered by the cook, struck a rock and swamped. Our loss was not as serious as when his canoe swamped on Lake of the Woods, and after a short delay we went on down stream to the end of the Bad Vermilion portage on Little Turtle lake.

We found this route between the Canadian Pacific railway and Shoal lake interesting as covering new ground; but with its twenty-three or more portages, mostly short, but a few very bad, and its very winding stretches of river, one loses time as compared with the old and roundabout route by Manitou lake and river, Rainy lake and Seine river. It seems as though few traverse the Little Wabigoon and Turtle route, since some of the portages look little used.

The Huronian-Laurentian contact near the height of land between the two rivers should be worthy of attention from prospectors.

Olive or Preston Mine.

A short visit was paid to the Preston mine before we crossed the long portage to Bad Vermilion lake, but as Mr. Preston, the manager, was away we found some difficulty in getting information regarding the property. Immense changes had been made since my first visit, when a tent on a point represented the only settlement. On July 10 we found a considerable area cleared and the work of clearing and burning still going on. Several houses had been built, a steam sawmill was on the ground and had furnished lumber for the building of the mill, then under way. It was stated that 25 men were employed, mainly on surface work.

Improvements at the Mine.

As the vein had been stripped only a short distance when I visited the location the previous summer, under the guidance of "Doc" Gardner, its discoverer, we looked over the ground more carefully now. The vein, which is distinctly a bedded one but usu well marked walls, widens and nar quently, running from six inches o about two feet in width, and having of about 80° with a dip of about 7 north. It may be that there ar lenses of ore overlapping one anoth country rock is a finely wrinkled. gray sericite schist or phyllite, called slate. The quartz contains a able amount of sulphides, pyrite, p and chalcopyrite, and also a little Contrary to the usual condition of a large lenses are said to be the richest

During a second visit to the regio ber I found that the Alaska mill heavy stamps, had been r short time; and Mr. Pre good enough to show me gold bricks produced and to give latest information regarding the mi shafts had been sunk, 400 feet apart being down 95 feet with drifts at th level, running 25 or 30 feet east an west. A winze was down 40 feet tance of 65 feet from the shaft.

An Alaska mill in operation.

During 16½ days' run about 109 rock from shaft A had been mille half slate. The result h 293½ oz. avoirdupois of g posed to be worth $16.50 per oz., a in value to $4,843, or about $44 per was supposed that from $1.75 to $4 in the tailings, owing to imperfect w the mill, and that there were 6½ of concentrates which would run a per ton. This showing is certai good, and if further development p continuance of the ore supply the mi prove valuable.

Mill test of the ore.

A wagon road has been cut fro Turtle to Bad Vermilion lakes, but rains and heavy traffic it was in a muddy condition on August 10.

Lower Seine Regio

The Lower Seine region has been described from the geological point in previous volumes of the Bureau Reports that nothing more need be s here. We found that development

on as rapidly as had been expected the
ous year. The Foley mine owing to
is vexatious delays in getting in its air
essors was not working full time, and
ork was proceeding at the Ferguson

October I found that the machinery for
oley was just on hand, and it was ex-
ey pected that the mine would soon be
in a condition to keep the mill
continuously. At that time the main
was down about 300 feet, and the vein
ged 3½ feet in width as compared with
hes in the upper part. At the 210-foot
he vein was 7½ feet wide to the north
shaft. About 400 feet of sinking and
et of drifting had been done in all early
ober. The quartz had not turned out
as was expected from the results of
, only about $12 per ton being obtained
e plates. The concentrates were not
ne per cent. and carried $75 to $100
n. Though the gold contents were less
ad been anticipated, they were quite
ent to yield a good profit from economining and milling, and it is to be hoped
he company's enterprise and persevervill be well rewarded. It was stated
he mill had produced $35,000 up to

AD2 mine is on the same area of protout farther north. We found the men
2 actively at work putting up camps
y. and a small two-stamp mill of a new
pattern. This property was sur-
April 15, 1894, having been found by
Campbell before the Wiegand mine, so
was the first discovery in the region.
D2 Mining Company of Duluth own
cation, as well as AD3 and 4. It is inated under the laws of Ontario, Mr.
. Butchart being president and Mr. W.
tt secretary. In October I found that
ll had proved a failure and had been
ed. At that time 18 or 20 men were
k, and the foreman, Mr. E. Falconer,
that a shaft 37 feet deep had been
on the Gem vein, and that a drift 135
length had been driven on the same
00 feet down the hillside, the vein
four feet wide. A mill run from this
s said to be very satisfactory in spite of the poor work done by the stamps. The Moose vein had been drifted on 75 feet, had distinct walls and was 3½ feet wide. A specimen of quartz from the mine assayed $10 per ton.

Just north of the Ferguson mine, in the Huronian beyond the protogine area, is the

Randolph or Golden Star Mine.

Randolph or Golden Star mine, AL114, 116 and JO4, belonging to the Seine River and Rainy Lake Exploration Company, Mr. Thomas A. Merritt being president, Mr. Edwin Ward manager and Mr. W. J. Merritt superintendent. The headquarters of the company are at Duluth. Eight miners were employed and eight surface men putting up camps. The ore here is very rusty or else charged with sulphides, the vein averaging five feet wide. A shaft had been sunk 45 feet on July 12. Two specimens taken from the dump assayed 1 dwt. and 3 oz. 7 dwt. per ton respectively. The dump was however not carefully sampled, and the results must not be looked on as giving the average value of the ore.

The Alice A mine, formerly known as the Archibald location, lies north of Wild Potato

The Alice A Mine.

lake, and in July was reached by a trail three miles in length, largely through muskeg; but now has a road connecting it with Bell City on Shoal lake. It is owned by the American-Canadian Gold Mining Co. of West Superior, Wis., Mr. A. S. Hillyer being president, and Mr. G. H. Hillyer manager.

Work was only beginning in July. A crosscut had been made across a band of rock showing many bedded veins, a pit about 10 feet deep having been sunk at each end. There was a considerable quantity of quartz to be seen, though the veins are very irregular. Some of the quartz contains iron pyrites, copper pyrites and galena, and rich specimens of gold have been obtained from the property. Much more development than we saw during our visit will be necessary to prove the value of such a property.

The country rock of the Alice A mine is felsite schist of the Huronian, but it lies not far from the Laurentian contact, which follows the channel of Little Turtle river. On the way north from Wild Potato lake some of the ridges of rock passed are schist

conglomerate, doubtless a continuation of the conglomerates of Shoal lake. The country traversed on the trail is on the whole very level, and with the exception of some muskeg and some ridges of rock should prove very favorable for the proposed Rainy River railway. The woods are mostly small second growth.

On July 14 we started up the river for the Sawbill region. As the route with its numerous portages has been described before, no reference need be made to it now.

The Harold Lake mine we found shut down with only a caretaker in charge.

Upper Seine Region.

We found much activity at the Sawbill and Hammond Reef mines, a 10-stamp mill being in process of erection on each property, and development work going on also.

Sawbill Mine.

At the Sawbill mine the shaft was down 155 feet, with 500 feet of drifting at two levels, 60 feet and 120. The vein was 18 feet wide at the bottom of the shaft. Sixty men were employed, 24 of them miners. As Mr. Bow's report will give full details, it will be unnecessary to do so here. The geology was taken up in last year's report. Since our visit the mill has been running on the large ore pile, with results that have disappointed those interested in the mine; the ore running much lower than had been estimated from the results of assays.

One end of the Hammond Reef "stockwork" is said to extend to the Sawbill property, and may be of importance in the future.

The Hammond Reef.

Extent and character of the Reef.

The Hammond Reef, or Dike, as it is often but incorrectly called, was visited and examined on July 17, 1897, and one or two following days. This remarkable "reef" consists of a zone of greatly shattered protogine or altered granite, in which quartz has been deposited, filling all the small fissures and cementing the rock together again. It may be followed for several locations in a direction about N. 25° E., roughly parallel to the southeastern shore of Sawbill lake.

The country rock is mapped by the geological survey as Laurentian hornblende gneiss, and Huronian schist crops out one or two northwest, so that the rock is far from the contact of the formations.

At the time of my visit a cross-cut was being made on location 33X to the west, being about 200 feet and about 26 feet deep. Location 33X

Back from the reef, fine grained granitoid gneiss, greenish reddish gray in color, occurs as exposed in the cut, the space between showing fresh and slickensided protogine (granite) with much intermixed quartz, the whole for about 100 feet. A band of green schistose rock towards the western side of the cut, found under the microscope to be largely dolomite with some chlorite, appears to influence the gold contents of the zone, the same rock occurring in its neighborhood. This green dolomite weathers red. In many places adjoining quartz, as well as the protogine, iron pyrites occurs in varying quantities, sometimes also a little galena, zincblende and magnetite.

The pay rock was stated to be about 30 feet wide, dipping 50° to the south. What was observed on the rough foot wall was a greenish schist. Some minute specks of free gold were visible in rock from the northeast corner of the cut and a panning of ore from the open cut gave a fair tail of gold, with a few colors for the greater part, but with a few larger particles.

There are three quartz veins associated with the reef, and on one near the mill a shaft 60 feet deep had been sunk. The quartz was not promising. Back of the open cut, dips about 40° towards south, and apparently runs into the reef. It is about three feet thick, carries free gold and affords fairly good quartz. A new vein was being explored somewhat to the northwest of the reef, averaging at least a foot in width, in some places much wider. This vein is nearly vertical, shows some free gold and carries much galena. The quartz looks well and stated to be low grade.

The cross-cut above described is said to be at the narrowest and least promising

ne zone, though it has furnished some free old all the way down.

On location 316X, towards the southwest, ne shattered band of protogine with inter-
ocation 16X. mixed quartz is much wider, at least 300 feet. Some of it is brec-ia-like, and portions are of green schist imilar to that already described. Here a eries of small pits and strippings has been arried across the zone or reef, disclosing on he whole better looking quartz than that at he open cut on 337X. A bit of rock from his portion weighing three or four ounces panned very well, showing a tail of very fine gold an inch and a half or two inches long. This was of course a selected piece, and no doubt ran much higher than the average.

At the time of my visit the mill was not completed, and no important test had been made of the ore; but I satisfied myself that the deposit, including shattered protogine and quartz, forming what the Germans call a "stockwork," is of immense dimensions, and that some parts of it at least carry gold.

As a good water power is available on Clearwater creek, two or three miles away, a large mill could be operated inexpensively; and I estimate that by working on a sufficient scale the huge ore body could be treated at a profit if it will average $5, or perhaps even less, of free milling gold. If the average rock runs above $5, it seems as if the mine should be a very profitable one; and if the whole width of from 100 to 300 feet, with a length of about three-fourths of a mile, as far as followed by myself, should turn out to be of workable grade, the mine must certainly be of very great magnitude and could be worked for a long time quite inexpensively as an open quarry.

Seven assays of ore from the Hammond Reef were made in the laboratory of the
Assays of the ore. School of Science, Toronto, chiefly from samples obtained on 316X. Three were select samples and of course ran above the general average. The highest, taken from a small cut 200 feet from the west wall on location 316X, yielded 3 oz. 3 dwt.; two others, 1 oz. 18 dwt. and 1 oz. 9 dwt. respectively. Three samples taken from average rock gave a trace, 4 dwt. and 16 dwt. per ton. A specimen picked up from the tramway ballast gave 1 oz. 19 dwt., but of course an average of the ballast would probably run much lower. The results of assays given here must not be taken as representing the average value of the ore, since no attempt was made to sample such an immense body of ore in a complete way, our time being too short for the purpose; but the results certainly show that the rock is auriferous over a considerable width.

The Hammond Reef was discovered by an Indian, who brought in Mr. Hammond to see it. The latter was at first much disappointed with the barren look of the rock and the absence of a distinct vein; afterwards, however, finding that the material panned well, he was better satisfied.

A short visit was made to the beautiful Clearwater lake which furnishes about a 50-
The Clearwater Falls. foot head of water, as shown by aneroid, in the descent of its creek to Sawbill lake. It lies entirely within the Huronian schists, and several locations have been taken up near its shores; but as little development work had been done on any of them and our time was limited, we decided to proceed on our way up Seine river. We found a busy canoe traffic on this formerly lonely waterway, numbers of visitors coming in from the railway at Bonheur, and Indians going out with empty canoes or returning with heavy loads of supplies. The Government road was advancing and had already cut off some bad portages.

On to Lac des Mille Lacs.

'At the entrance to Sawbill lake on the Seine river is a camp of the Toronto and
Toronto and Western Co. Western Company. The cook, in the absence of the manager, Mr. E. W. Lockman, informed me that they were developing two properties, 412X down the river and 393X up. The latter was visited, and proved to be a zone of shattered granite running north 25° west, containing numerous quartz stringers. The widest of these was 18 inches, the average about a foot. The quartz contains a little iron pyrites and sericite, and specks of free gold are found. The shattered zone extends

over a bare hill, and on this three pits a few feet deep had been sunk, the extreme ones being 200 feet apart. Three miners were at work sinking one of these pits. W.'

About two miles above Sawbill lake, at the point where the river enters Lynx Head lake,

Location AL 66.

Mr. M. W. Bates owns AL66. Here an ore body somewhat like the Hammond reef is being opened up. The band of quartz mixed with some green schist strikes about north 35° east. The green rock becomes rusty on weathering, and the quartz, which is rather white, contains some pyrites, the whole being about 50 feet wide at the crosscut. It is not expected that the deposit will prove high grade, but it is hoped that it may be worked profitably on a large scale; and an adjoining fall of 12½ feet on the river will furnish cheap power for a mill.

On an island belonging to the same location there is a vein four feet wide, running parallel to the main reef but a few hundred feet to the southeast, the quartz containing a considerable amount of iron and copper pyrites. Eight chains from the last, at the east end of the island, there is a well defined vein 5½ or six feet wide containing white and rosy quartz with much copper pyrites. This vein has a good foot wall, but less perfect hanging wall. It is in greenish, much shattered protogine.

At the Hawk Bay mine, 324X, under the directorship of Mr. H. A. Wiley, we found

Hawk Bay Mine.

Mr. W. A. Harvey as superintendent, who kindly took us around the property. Two shafts were sunk 432 feet apart, one to 80 the other to 90 feet. At the bottom of the 80-foot shaft we found the vein rather pinched, being not more than a foot wide. The main vein on which the shafts are and a smaller parallel one, 125 feet to the west, are very irregular as traced in the surface and are seen equally irregular below ground. The vein strikes about 25° and is nearly vertical in the upper part of the shaft. The quartz is rather white, and the country rock is a greenish gneiss with an east and west strike. The mine, which had 18 men at work in July, has since shut down.

325X, owned by Messrs. Hendry, Tilden and Co., lies to the northeast of the Hawk Bay mine. Here Mr. E. Giessen a intendent with 11 men was sinking a

Location 325X.

a vein running north 30° e having a width on the of about 2½ feet. The quartz, whi very like that of 324X, is associat green chlorite schist. The shaft was deep on July 19.

'North of Reserve island is locatio A zone of sheared granite running n

Location 277X.

east crosses a point of p granite for about 200 fee zone averages about 10 or 12 feet a small included masses of green Quartz occurs in this decomposed gra included schist in narrow, irregula The thickest vein seen was 15 inc where it was exposed in a pit about deep. At the other end of the s about 150 feet distant, a second pit deep and 10 wide had been made. sulphide is seen in the quartz o although the latter weathers to a pro red or yellow. The workmen wer for supplies at the time, and no inf as to the company was obtained. W

AL 281, 282 and 283 lie a half mi from a bay projecting northeast of

Locations AL 281, 282 and 283.

island. These locations w ed on July 20, under the of Mr. Hammond, who was a to some development work at the ti men being employed in stripping and pits upon these recently discovered A vein runs northeast and southwest a greenish or gray granitoid gneiss. is often a ridge of Laurentian rock northwest side, the vein showing al greenish sheared protogine and a w rusty schistose rock at the bottom. been traced more or less continuousl miles. In some places the quartz w rusty schist is 10 or more feet wide places no quartz, only rusty schist, seen. The vein dips 50° or 60° to th west, under the ridge just mentione quartz often looks well, is mixed wi green chlorite in places and carries deal of free gold in at least som Three-eighths of a mile to the northw is a quartz vein running roughly pa the previous one, also in the Laurent

is said to have been traced over two miles. The vein is sometimes from six to 10 feet wide and has along side, in some places at least, a band of green schist. The hanging wall, where we saw the vein, is partly talcose, partly protogine. The foot wall was not well exposed. This vein dips about 80° to the northwest. Much of the quartz looks very white. Dikes of diabase run through the granitoid gneiss parallel to this vein.

This and the previously mentioned vein were stated to have been found in June by A. J. Leguyer, who was associated with Messrs. L. Roy, J. Savord and James Hammond. This prospecting party had found several new lakes, one six miles in length, in the region they had worked over.

In January Mr. Hammond informed me that a shaft had been sunk in the granite on the northwest side of the first mentioned vein, 40 feet from it. The shaft was then 96 feet deep, and the vein had been struck at 77 feet. Drifting had been begun in each direction.

On July 21 we set out for Savanne, via Partridge lake and river and Lac des Mille Lacs. As the route was described in the last report of the Bureau of Mines no further mention of it is required here. Strong head winds hampered our progress, and on the following day almost made canoeing impossible on the wide northern reach of Lac des Mille Lacs. Fortunately the small steamer plying on the lake picked us up and took us in to Savanne.

Across Lac des Mille Lacs to Savanne.

East on the C. P. R. Line.

On the following day we reached Fort William, and spent this and the next day in visiting some interesting localities near by and in obtaining information. An excursion was made to the top of McKay mountain to look for glacial phenomena and to settle the height of the old beaches so well shown on the mountain side. We found well marked glacial grooves on the very top of the mountain, having a direction of north 60° east, with rounded surfaces to the northeast and rough ones on the lee side to the southwest. We made the height of the mountain almost exactly 1,000 feet above lake Superior, the plateau on which the chapel stands being 517 feet above the lake. These measurements accord fairly well with those made on a previous occasion. The meanderings of the Kaministiquia through its low alluvial plain are seen from the mountain top as if on a map, and the ox-bow lakes left behind by changes of the channel are specially interesting.

On McKay Mountain at Fort William.

Availing ourselves of an excursion, we visited Kakabeka on the Kaministiquia, so as to study the section of the Animikie shown there in the gorge. A fine series of terraces may be seen on the way to the falls, which are in themselves magnificent. The brown water foams into creamy white in the descent, and is very beautiful though so entirely unlike the clear blue-green of Niagara. An enormous waterpower is available here if required for electrical smelting or other purposes in the future.

Kakabeka Falls on the Kaministiquia.

The soft, almost horizontal Animikie slate, with its bands of chert, makes a great contrast with the much folded, highly crystalline Laurentian and Huronian rocks among which we had been working for the past few weeks, and on which it rests unconformably.

On our way east Professor Willmott visited Schreiber and the Empress mine at Jackfish, which I had examined on a previous occasion; and I stopped at Peninsula and Missanabie.

Peninsula to Port Coldwell.

As it was reported that iron ore had been found near Peninsula I stopped there a day and walked west along the railway to Port Coldwell. I found however that no one at Peninsula knew of any iron deposits of importance. Mr. Mudge, hotel keeper at the place, and the foreman of the section kindly went with me as guides for part of the way. The region traversed is almost mountainous, lofty and precipitous hills rising all around. The coast of lake Superior is very grand along this part of the railway. The rocks for the greater part of the distance are syenites, dark gray or red in color; but about five miles west of Peninsula dark green, very fine grained amygdaloids occur to the north of

A reported iron ore discovery.

the railway. A few thin seams of magnetite occur in this rock within a mile of the railway, near a small lake with rugged walls of rock. The thickest vein is not more than an inch or two, so that the ore deposits are of no importance. Black sand (magnetite) occurs a mile or two east of Peninsula, but not in large beds.

Pic river and Port Coldwell.

Pic river flows into lake Superior between Peninsula and Port Coldwell, and large and small veins, said to carry gold in fair quantities, are reported from points up this river; but I had neither time nor a guide to visit them.

Port Coldwell is a picturesque fishing village surrounded by very striking scenery. The rocks observed along the way will in the future perhaps furnish useful building and ornamental stone, since syenites of all colors from black to red and pale gray, as well as diorite, both dark and light gray, occur in great quantities at points where quarries could be located close to harbors. The characters of these rocks will be described in the petrographical section of this Report.

Schreiber and its Vicinity.

The pyrite deposit on R606.

'A little over a mile from Schrieber is the pyrite deposit on location R606 owned by the Davis Sulphur Ore Company of New York. The president is H. J. Davis; treasurer, C. B. Stranahan. The country rock is a diabase, through which a dike of granite has been erupted. The pyrites deposit extends at right angles to this dike up to it, but not beyond it. The deposit has been uncovered for about 70 feet and has a width of three to 10 feet. On the surface it has decomposed to a gossan for about 10 feet, which has all been removed. The ore is mostly pyrite, though there is considerable pyrrhotite in places. The latter frequently carries chalcopyrite. The pyrrhotite is considered useless as a source of sulphur. The pyrite is very pure and a trial shipment is said to have given good satisfaction. At the time the property was visited a tunnel was being driven into the hill to prove the width of the deposit at a depth of 25 feet. If the deposit proves as extensive as supposed a tramway will be built to lake Superior and the ore can then be cheaply shipped to the American market. T sent owners have had long experi manufacturing sulphuric acid. Thei in Massachusetts are now nearly exh and they are looking to lake Superior material. The mine foreman said understood $15,000 had been paid property.

'A few hundred yards from the pyr bonaceous shales outcrop along the ba small creek. A pit was excavated in of the hill under the impression t material was graphite. Several ba the more graphitic shales were standi by. No more work is being done he is realized that the substance is useles

'The following morning I went w Samuel Otisse to see the locations o he is managing the development. W

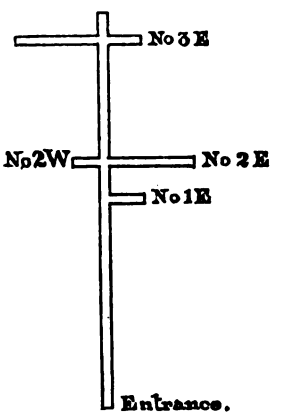
The Otisse Mining Company.

east of Schreiber for four on a Canadian Pacific loco and then followed a good the north of the track for three-quart mile. The locations AL216 and 2 owned by the Otisse Mining Comp Schrieber. President, George Marks Arthur; secretary, Alfred Peters of Sch capital, $1,000,000 in $1 shares. Fiv have been found on the property, b one has been worked. This, the mai runs about northeast in diorite schist shafts have been sunk on the vein 1,2 apart. No. 1 was down 34 feet and sh band of quartz four feet wide mixed little schist. The south wall is well-def a dike of diabase running with the On the north the wall is not clearly d No. 2 shaft, situated on a hill, has be for 30 feet. The quartz is here mix schist as in No. 1, and the same dike of forms a definite wall on the south. The is blue-gray in color, with considerable and a little visible gold. In No. 2 pyrrhotite is seen in the quartz. A m of one ton made at Kingston gave $1 the value of the free gold and concen A sample taken for assay gave $15 per the School of Science. W.'

The Empress Mine.

'At Jackfish bay I met the caretaker Empress mine and he was kind enou

me in and show me the property, h not without some misgivings. The mine was closed down and he had of gs at ie. strict orders to admit no one to the underground workings. After trouble I succeeded in persuading him I had a right to enter and that I could vait for two days to obtain permission the president. The early workings and nill have been sufficiently described by Coleman in the sixth Report of the au of Mines, p. 110. Since his visit the el has been driven into the side of the ntersecting the veins and permitting of economical working to that level. All s delivered by gravity at the top of the and no pumping is necessary to drain present work-



Mr. Bow, the ector, and my- measured with ie the length of tunnel and s, a plan of h is here given ie scale of 200 to the inch. From the en- ce of the tunnel o. 1 vein is 229 A drift has carried along r 35 feet to the The vein is t eight feet wide and pretty uniform. the tunnel a little stoping has been , the only work of the kind under- nd. The whole vein seems well mineral-

On the west side only a shot or two been put in this vein, but there is a large ring of quartz. Just south of the vein t 20 feet of well-mineralized quartz is on the side of the tunnel. A little h of the same drift there is a similar ring six to nine feet wide. Nothing has done with these veins yet. No. 2 vein it by the tunnel 263 feet from the ance. A drift has been run 82 feet to east along a vein six to eight feet wide. he end of the drift the vein is seven feet , of which about one-half is quartz and rest schist. On the west a drift has been carried 31 feet on No. 2 vein, where it pinches out entirely. In the roof of the drift near this tunnel there seems to be plenty of quartz. Seven feet north of No. 2 drift a vein of quartz well mineralized and seven feet wide is seen on the face of the tunnel dipping 45° south. The third drift was begun 386 feet from the entrance of the tunnel. To the east it was carried 32 feet along a vein eight feet wide. The vein material consists of quartz carrying pyrites in considerable schist. In places about half of the vein is quartz. On the west the drift has been run 84 feet along a vein averaging about seven feet. As on the east, the quartz is distributed through considerable schist. At the end of the drift the thickest single piece of quartz was six inches. Nearer the tunnel there was more quartz. The tunnel has been run 31 feet beyond the third drift. Below the mouth of the tunnel is a large, high ore dump of quartz and pyritous schist in about equal proportions.

'The buildings at the mine are very neat and complete. They comprise the stamp mill, sleeping and eating camp, assay office, blacksmith shop, machine shop, dressing room, powder houses, stables, grain shed, oil house and pump house. Previous to the driving of the tunnel considerable surface work was done. A number of test pits were sunk and some mining in an open cut. These have now all been abandoned.

'At the end of July the mine was closed pending a report on the property. The richness of the quartz is hardly up to expectations, and it is understood that the directors contemplate sinking a shaft to prove the amount of vein material. If this is as great as supposed a much larger mill will be erected. Assays of four samples of the ore ranged from $1 to $4, averaging $2.50 per ton. The concentrates, containing a good deal of sand, yielded $6 per ton.

'On the road from the Empress to Jackfish bay I passed the Mogotherium mine, owned by the Jackfish Mining Syndicate. Mogotherium Mine. Mr. J. T. Horne of Fort William is the manager, but no work was going on at the time. Some of the workmen still camped on the property told me that the vein had been traced for half a mile and pits were

sunk at intervals. I visited the deepest of these pits. At one there is a vein of white quartz in granite and carrying pyrites and galena. The vein is somewhat irregular, the quartz and granite being mixed. No free gold is visible, but some is found by assaying. At another pit the walls are of schist and the quartz occurs in stringers through it. A little free gold has been found here. The quartz is very white, but carries pyrite, chalcopyrite and galena in small quantities.

'On the east side of Jackfish bay is the Megatherium mine, owned by the same company as the Mogotherium. As it was not working, and as I was told there was nothing to be seen but a shaft full of water, I did not think it worth while to lose a day by stopping to examine it. A sawmill has been erected on the property to provide lumber for a stamp mill, which apparently will not be required for some time. W.'

Megatherium Mine.

Missanabie Station.

Three and a half miles west of Missanabie Station on the C. P. R. there is a cutting in which coal was supposed to occur. A visit to the spot showed that the material taken for coal is only a black volcanic glass, which has been formed by rapid cooling of the edges and thinner parts of several diabase dikes, the largest one about a foot and a half wide. The country rock is a slate or phyllite. A pit 10 feet deep has been sunk north of the railway upon the largest dike, there only a few inches wide.

An "exposed" coal deposit.

Part of a day was spent in visiting some gold locations on the shores of Dog lake, seven miles southwest of Missanabie, and easily reached by canoe from the station. Here Mr. John Halliday has taken up two locations of 40 acres showing numerous veins and irregular masses of quartz in a country rock of green altered diabase, much shattered in places, the fissures being filled with quartz. A dike of granite or felsite and some patches of coarse grained diabase occur in the fine grained altered rock, not far from some of the veins. Part of the granite is changed to protogine. One of the veins is 3½ feet thick and is traceable some distance along a ravine. It lies very flat, but is irregular, so that the dip was hard to determine. As a rule the q white, but portions of it contain pyri galena. Free gold is not seen in the portions of it show gold when assayed

Gold locations.

These locations may be looked on as ing to the most northerly part of the picoton mining region, which ha described by Professor Willmott in part of this Report.

Wahnapitae Region

The nearest of our new northern go to the more populous parts of the P is that of Wahnapitae, since and stage it may be reache Toronto in twenty-four Sudbury is the natural capital of t mining region, though it is generally of only in connection with mines o and copper.

Routes to the Wahnapitae country.

Lake Wahnapitæ may be reache stage drive of about 20 miles fro bury, or by a somewhat shorter, stonier road from Wahnapitae station the C.P.R. crosses Wahnapitae river. Boland's Landing on a deep bay to t of the lake a steamer plies to the Cry other mines on the east side of Wah the distance being about ten miles. hours' canoeing with two or three lead from this point to the more properties of the region, about Kook lake. From the south end of this lak somewhat shorter than the two that ha mentioned leads south to Markstay, th station east of Wahnapitæ on the C Pacific.

Much of the country between t region and the points mentioned a railway, Sudbury and Wahna covered with thick drift d so that little solid rock is and prospecting can hardly ried on; but east of lake napitae this difficulty vanishes, and the ous small lakes with many bays and afford excellent rock exposures. This the region corresponds precisely to the lake country" of Lake of the Woods

Geology of the region, compared with Lake of the Woods district.

The region is covered by Dr. Bell's the districts of Algoma and Nipissin bury Sheet) published by the Ge

y in 1891, and the corresponding map, /hat revised, published by the Bureau nes in 1892. These maps are of much in studying the geology of the region, h, as one expects when a large tract of lt country is mapped in a limited time, are minor points requiring changes.

› geology of the region was described years ago by Alexander Murray[1], and recently by Dr. Bell[2], in connection the Geological Survey.

rocks of the gold region as mapped)r. Bell are entirely Huronian, with rous eruptive masses of greenstone :e or diabase) penetrating them. The lent varieties are pale quartzites and ackes, the latter sometimes slaty or ve in appearance, and often containing ·ly scattered pebbles of granite, syenite per. A gray limestone occurs on Wah- ıe river to the south, but is not widely in the gold district.

general there are considerable differ- between the geology of this gold region that around Lake of the Woods and ' lake. In the more westerly gold dis- quartzites are rare and graywackes only rately prevalent, while green schists are ommonest rocks. As a general rule, in the western region gold is found y near the contact of Huronian with the ıntian gneiss and granite. Here how- gold deposits are found eight or ten away from the nearest Laurentian ct.

July 29 Professor Willmott and the r left Sudbury by stage for Wahnapitae, a distance of 16 miles in a straight line, but several miles far- thor by the somewhat crooked road. ıe way the pleistocene deposits proved ıch interest. For six miles to the north ast of Sudbury there are plains of clay ilt forming good soil, evidently old lake ıits. Most of this part of the route is ıettled and the farms showed good crops nothy and clover and fields of oats, etc.

yond the lacustrine clays there are level plains of sand, probably deposited by glacial streams from an ice-foot to the east. A few farms are occupied on these barren looking plains. Some miles through the sand bring one to the Holland and Emery Lumber Company's Headquarters camp, where one is surprised to find a small village and a narrow gauge railway used in lumbering.[3] This road runs from a point on the Wahnapitae river a mile or two north of Wahnapitae station on the C. P. R., and branches out in various directions over the sandy and stony plains. When the timber is cut from one portion the rails are taken up and relaid toward another point. Much of the grading is done by trestles or filling with logs. This is perhaps the only railway in the Province having no direct connection with any other road. It was once built down to the C. P. R., but a bridge at that end of the road has become unsafe, so that the last mile or two of the railway have been abandoned.

From the Headquarters camp there are about eight miles of travel to Boland's Landing on lake Wahnapitae, mostly over a very interesting moraine country, in general fairly level, but often broken by kettle holes of immense size. The largest kettle is three-quarters of a mile in length by a quarter of a mile in breadth, and is 165 feet deep (aneroid). There is a small lake covering the lowest part of the bottom, and this is said to be 60 feet deep.

Descending towards lake Wahnapitae a series of quite distinct terraces occurs, the descent being about 290 feet as shown by aneroid.

The road was muddy and bad in places on the clay land near Sudbury, but dry and fairly good over the sand plains and morainic region. Several miles of it follow the abandoned road bed of part of the Emery railway. While we were at Wahnapitae a force of men employed by the Government were effecting great improvements in the road, straightening crooked parts and regrading others.

Except on a hillside near Headquarters camp, no rock was seen in place after leaving the hills about Sudbury until lake Wahnapitae was reached.

y to pitae.

eol. Sur. Can., 1853-56, p. 174, etc.

›id., 1890-91, part F, especially p. 14 and ing pages.

[3] Mentioned by E. M. Burwash, Bur. Min Report, 1896, p. 167.

South of Lake Wahnapitae.

Lake Wahnapitae is a fine body of water, unusually free from islands except along its southeastern side. It is about 10 miles in greatest length from east to west and about eight from north to south, affording stretches of open water dangerous for canoes in windy weather. The lake is reputed to be very deep, but a sounding made with trolling lines in the bay a mile north of Boland's showed a depth of only 130 feet where 1,200 had been reported. It is probable that the wider part of the lake, which is quite free from islands, is much deeper. The Wahnapitae river enters the lake on the north side and leaves it from Outlet bay on the southeastern end. It affords an excellent water power between this and the railway.

Lake Wahnapitae

No mines are worked on lake Wahnapitae itself, though the Sheppard mine was operated some years ago for a short time on the north side of the promontory between the two southern bays. The workings consist of a short drift into the face of a hill near the shore, and of a small open cut near the top of the same hill. The openings show only narrow quartz stringers, now apparently almost worked out. What ore was obtained is said to have been rich, and was treated in an arrastra after the Mexican plan. The stone pavement with its round wall of wood and some parts of the framework as well as the heavy stone blocks dragged round on the pavement by horse power to grind the ore are still to be seen. So far as known this is the only arrastra which has been used in the Ontario gold region; although for free milling ores this method is said to give good results with comparatively small expense for machinery.

Sheppard mine and workings.

The country rock appears on microscopic examination to be partly granite and partly arkose, interesting from the fact that some parts of the rock are crowded with crystals of mispickel. The shore near the arrastra is of a pale flesh colored quartzite, or rather arkose, since it contains much felspar, easily mistaken for granite.[4]

[4] Royal Com. on Mineral Resources of Ontario, p. 435.

A mile or two south of this the Mar vein was found by John Boland nine ago and more or less explor the Bonanza Nickel Mining pany, who own nickel properties nea lake. The vein can be reached from (bay by a trail through the woods, abou miles in length, or by a road four mile from Boland's Landing. The propert along a small lake, and the white q sometimes 50 or more feet in width, (followed more than a quarter of a With the quartz is much of a coarsely talline carbonate, weathering brown, few sulphides. In large vugs immens tals of quartz with much corroded su are found. The country rock is diaba along one wall a few feet of impure do may be seen. At the eastern end vein a shaft has been sunk 60 feet, a feet of drifting has been done at the 3 level. The Government diamond dri employed in exploring this body of in 1895,[5] when two holes were d Although portions of this great mass of carry gold, the average appears to be t in grade to be workable.

The Mammoth vein.

North of Lake Wahnapitae.

The Crystal mine on a small bay o connected with the eastern side of lake napitae by a narrow channe navigable by the little st which brings supplies and passengers far the most important mine in the r In fact no other property has been developed as to be properly called a The rocks observed on the proper mainly diabase, sometimes containing (and a dark green compact chlorite-do rock, having a very flinty fracture. foot of the small hill where most of the occur there is a little outcrop of gran perhaps very acid quartz diorite, whic have had an important effect on the tion of the veins. These are several in ber and irregular in thickness and dip, times making sharp bends and enclosing of country rock. On the whole howeve seems to be a large amount of quartz, s present development has opened up the

Crystal Gold Mine.

[5] Bur. Mines Report, 1895, p. 229.

No. 1 shaft, the most easterly, was down 40 feet at the time of our visit and showed a vein 16 inches wide, containing quartz with chalcopyrite, pyrrhotite and iron pyrites. The vein dips 80° to the south and strikes S. S. E. and W. N. W. No. 2 vein is very flat at first and broken into several portions running at varying angles, but dipping down at the bottom. Many horses of country rock are enclosed in it, but its average thickness is about 20 inches. Two short drifts have been run on this vein, meeting a short distance in. No. 3 shaft has been sunk to 100 feet deep from the top of the hill, striking a vein two feet wide at the depth of 85 feet, and a drift had been run 35 feet into the hill towards it from below but had not yet met the shaft. The quartz from this drift contains much of a carbonate which weathers brown, probably dolomite or ankerite, and small quantities of sulphides.

Workings on the location.

A five-stamp mill made by the Jenckes Machine Company had just finished its first run while we were there. Things were apparently running smoothly under a practical mill man from Nova Scotia, who informed us that the stamps dropped five or at most seven inches, 85 times per minute, with a 35-mesh screen. The gold is 85 or 90 per cent. free milling, and 90 per cent. of the coarse gold is saved in the mortar box. Only a small percentage of concentrates was obtained by the Frue vanner, but the tailings seemed fairly clean. The brick of gold just secured was said to represent about $15 per ton of ore crushed.

The stamp mill.

The name "Crystal" was applied to the mine because of the handsome gold specimens obtained from it, some of them showing plane surfaces. They are not however true crystals, since the surfaces result from contact with smooth faces of quartz, the gold forming plates in thin fissures in the quartz. The mine affords a certain amount of ore much richer than that treated in the first mill run.

Thanks are due to the Hon. Peter White, president of the company, and Mr. R. McConnell, general manager, for accompanying us through the mine and mill.

The Comstock mine is situated just to the south of the Crystal and shows similar geological conditions. As the man in charge refused to let us enter the shaft, there is nothing further to be said of the property.

Comstock Mine.

Having engaged John Boland, the pioneer of the district, as guide and canoeman, we portaged into Matagamishing lake (pronounced by the inhabitants, Matog-amisheen), crossed the lower end of this lake and ascended the crooked McLaren creek for about two miles, where a long and sometimes steep portage leads eastward to lake Kookagaming (pronounced Kokogaming). This is a complex body of water with intricate channels and several long points and islands, making navigation puzzling to the newcomer. A portage of a chain or two across a sandy point saves several miles of paddling when on the way to the main lake. The map is unfortunately not very accurate as regards this lake, which, though only about six miles long, has a very extensive shore line.

Kookagaming Lake.

There are several prospects on and near the lake, and we visited most of those on which any work had been done. A quarter of a mile north of the portage across the sandy point a small boss of quartz porphyry shows itself on the west shore, and a quarter of a mile beyond this a fissile slate occurs. The northern expansion of the lake is connected with the main lake by a narrow channel 100 feet long, having a marked current when we passed it, so that one might properly speak of this northern bay as a separate lake. It has the same clear, colorless water and green, unburnt shores as the mainlake.

Some distance beyond the narrows, on the eastern shore, one sees a log house, the Gold Cliff Mining Company's camp, where we found two men in charge. They took us across the peninsula to another bay, where on the very steep shore a tunnel had been driven in, it was said, for 180 feet. As the mouth of the tunnel was boarded in and locked we were unable to enter it. The quartz on the dump contains much dolomite and some sulphides. Small veins near the top of the steep bluff 70 feet above contain

Gold Cliff Mine.

rusty quartz with copper pyrites. One of the small veins was reputed to be rich in free gold. The country rock is apparently a fine grained graywacke, containing a few small rounded pebbles of red granite.

Moose Mine.

At the south end of Kookagaming lake we visited the Moose mine, WD32, located in 1892, the oldest location on the lake excepting M1 and M2. Here there are several well defined fissure veins in a slaty gray rock containing angular granite fragments. No. 1 vein runs about 120° and dips 45° to the southwest, is about 18 inches wide, and can be traced some hundreds of yards. The quartz is white, containing pyrite, chalcopyrite and galena. Some fragments containing free gold were picked up during our visit. The only development is a pit about 10 feet deep. A sharply walled vein a foot wide runs paralled to it a short distance away, and several other veins two feet wide or narrower may be seen, but the quartz they carry looks less promising. A small mill of a peculiar kind, too frail and light to be of real use so far as one could see, stood in a leaky house not far off; and a fairly good log house on the bay served as dwelling for the man in charge, E. T. Havard, who merits our thanks for his hospitality and kindness in serving as guide.

Location WR35.

We next crossed a portage toward a small lake to the south and visited WR35, said to be owned by Ewan Mackenzie, of Toronto. The main vein here is from six inches to a foot or more wide, runs about 140° and dips 45° to the southwest. The country rock appears to be similar to those mentioned previously, and encloses fragments of felsite and granite. A shaft had been sunk 35 feet on the incline, and the quartz on the dump looked well, containing pyrites and a carbonate resembling ankerite, as well as free gold. There is a smaller parallel vein a few feet to the southwest, also included in the shaft.

Location WD66.

On WD66, a location near the southeast end of the lake, owned by Mr. Charles Ford, there is a vein about ten inches wide, running nearly east and west and dipping 65° to the south. It is irregular, but can be traced for some distance. There is a distinct foot wall, but the hanging wall is not so well marked. The country rock is coarse grained quartz diabase. About 30 feet to the north a parallel strip of quartz runs in a shattered band of rock about six feet wide; and several small stringers three or four inches wide run diagonally toward the main vein. The quartz is heavily impregnated with iron and copper pyrites and contains a little native copper and peacock ore (bornite). Some free gold can be seen, and the rock pans. Still another vein occurs on the property, running northwest and southeast, and having a width of a few inches to two feet. It contains much copper pyrites in places. A small dike of diabase runs parallel to the main vein and has a band of quartz along one side, as if the fissure it followed had opened a second time.

On the whole one may say that the veins in this area of quartz diabase are much less regular than those in the graywacke and ash rocks described above. Our thanks are due to Mr. Ford for his kindness in various ways.

North of the Moose mine a hill of light flesh color attracted our attention, suggesting a boss of granite. A climb to its top showed about half a square mile of hills formed of a rock much like binary granite in appearance. A careful microscopic examination since returning to Toronto proves however that the rock is really an arkose, a rock consisting of grains of quartz and felspar cemented together, or perhaps a crushed and reconsolidated granite. A very similar rock occurs on the shore of lake Wahnapitae at Sheppard's mine.

Prospects on and near lake Matagamishing.

On our return to the Crystal mine we visited one or two prospects on lake Matagamishing. At the Last Chance, on the bay forming the south end of the lake, may be seen a vein six or eight inches wide, said to be traceable for a long distance. It runs about 10° south of east and dips slightly to the south. The country rock is coarse diabase. The quartz looks well and carries free gold. Two men were at work on a shaft, which was 18 feet deep at the time. There are several other veins of similar size on the property, but not so rich as the one worked.

We tried to find the Hub mine, a mile inland on the east side of the lake, but failed in our search, since lumbermen's trails were

Portage between Wabatongusheen Lake and Loch Alsh. Photograph by Miller.

On a tributary stream of Oba Lake, near the height of land. Photograph by Willmot.

Old Tote-road Landing at north end of Manitowick Lake. Photograph by Willmott.

Falls on Michipicoten River at Little Stony portage. Photograph by Willmott.

Running a current light on Michipicoten River, above High Falls. Photograph by Willmott.

Camp at head of High Falls, Michipicoten River. Photograph by Willmott.

Bed of Michipicoton River at High Falls during low water. Photograph by Willmott.

Pot-hole in bed of Michipicoton River at High Falls.. Photograph by Willmott.

View of the upper end of Wawa Lake. Photograph by Miller.

Cliff on north shore of Wawa Lake.

numerous and we could not obtain a guide. It was stated that a shaft was sunk there on a vein 12 feet wide, and that the quartz assayed well. The two properties just referred to are about two miles east of the Crystal mine.

A mile or two north of this we observed a bed of quartzite containing a breccia with angular fragments of greenstone, but no gold bearing veins are reported from the quartzite, which appears to be uniformily barren.

To the north of lake Wahnapitae iron ores have been found, both magnetite and hema-

Discoveries of Iron Ore.

tite, but as there was no guide available, and we were informed that the ore beds are inland and hard to reach, we decided not to visit them on this occasion.

Too little work has been done in the Wahnapitae gold region to justify any very decided

Comparison with Lake of the Woods region.

statements regarding its importance, since only one mine has actually begun to produce bullion, and even that had no shaft deeper than a hundred feet on the 1st of August. The area in which gold has been found is small as compared with the gold field of western Ontario, a fact probably accounted for by the relatively small number of prospectors in the field and the limitation of prospecting in districts containing pine.

So far as our observations go, the gold bearing veins occur in quite different country rocks from those of the Rainy Lake region, most of the veins being in impure dolomite, graywacke or diabase, all of Huronian age and at a distance from any Laurentian contact. In the case of the Crystal mine a small eruption of granite seems to have had an influence on the production of the ore bodies, but no other examples of the kind were seen, if the small stringers of quartz in granite containing mispickel at the Sheppard mine are left out of account.

We saw only one body of quartz of large size, the Mammoth vein of the Bonanza Nickel Mining Company, but this seems to be of too low grade to work at a profit. On the other hand there are several veins of moderate size and numerous small veins which have been proved to carry gold, sometimes very richly, the finest specimens obtained in Ontario having come from the Crystal mine. If this promising property proves as productive in depth as it has been near the surface, its owners should be satisfied.

The fact that in the Wahnapitae district rich, if not very large, veins of gold quartz can be reached from the capital of Ontario in 24 hours, should attract attention to this hitherto rather neglected region.

Sudbury Region

Small veins said to carry gold occur on the rocky hills about Sudbury, but no work of

Minerals in Fairbank and Denison townships.

any importance has been done on them and we did not take time to visit them. A day was devoted to visiting the Citizens' Coal, Gold and Nickel Mining Company's property in Fairbank township, near Vermilion river, but some analyses not being complete, no report will be made at present. A visit was made to the McConnell mine, and also to the adjoining Vermilion mine, 20 miles southwest of Sudbury and a short distance north of the "Soo" line.

At the McConnell mine, lot 8, con. 4, Denison township, we found active work going on stripping a large deposit of nickeliferous pyrrhotite. It is stated that the rusty gossan can be followed through several adjoining lots for a distance of about two miles. Where pits had been sunk through the gossan to the fresh sulphides, masses of copper pyrites and pyrrhotite (magnetic pyrites) mixed with some quartz were disclosed, giving promise of an important body of nickel-copper ore. The country rock is diorite with some hornblende schist, on the north side of a band of diorite (or perhaps altered gabbro or diabase) near a narrow outcrop of "syenite" as it is called locally, really crushed and sheared granite. The Drury mine is said to be on the north side of the same band of diorite, and the Vermilion and Worthington mines to be on the south side of it. Rock obtained from properties on both sides of this band contain gold and the interesting platinum ore, Sperrylite ($PtAs^2$), both of which may be obtained by panning. Sperrylite, it will be remembered, has been found nowhere else in the world than in this district. It is probable that the small amount of platinum

obtained from the Copper Cliff nickel-copper ores comes from the same mineral.

Vermilion Mine.

The Vermilion mine, a short distance to the east across a small lake, though worked some years ago has been idle for a long time, owing it is said to disputes as to ownership. Mr. W. G. Duncan, a farmer near by, well acquainted with the mine when it was being worked, took us over the property, which is of special interest from the variety of metals it contains, gold, platinum, nickel and copper. Three small shafts have been sunk on the property, No. 1, the deepest, going down 60 feet. It is stated that ore containing 42 per cent. of nickel is found at the foot of the shaft on the south side. The country rock is diabase, with some diorite schist, felsite and quartzite. The ore body is quite irregular in its boundaries and is weathered to gossan to the depth of six feet, since the mixture of pyrrhotite and copper pyrites very readily oxidizes to sulphates, which afterward afford oxides. Some of this rusty, porous ore taken from the upper part of the shaft by myself, assayed two dwt. per ton of gold and 38 dwt. (=59 grams) of platinum, showing a very valuable ore; and portions of the rusty sand show a long string of bright tin-white particles of Sperrylite when panned. Quite large pieces of native copper have been obtained from this ore body.[6]

[6] On the subject of platinum, its identification, sources of supply and separation of the ore, the following extract from a circular recently issued by Baker & Co. of Newark, N. J., will be interesting and instructive to prospectors:

The constantly-increasing demand for platinum in the arts and manufactures of the world, and the present limited sources of supply, have in recent years greatly enhanced the price of the metal. Because of the peculiar and valuable qualities of platinum it is believed that the consumption of the metal would be greatly increased if the supply was sufficient to materially lower the cost.

This circular is issued for the purpose of calling the attention of prospectors and miners to the increasing demand for the metal, even at present prices, and to the wide distribution of the ore, with the hope that by their aid new and rich deposits of the same may be located.

Contrary to popular impression, platinum and associated metals are widely distributed, although they have thus far been found in paying quantities in but few localities. This condition is perhaps largely due to the higher intrinsic value of gold and to the limited acquaintance of prospectors and miners with the means of identifying platinum ore and of its economic separation. Up to the present time the platinum of commerce has been obtained entirely from alluvial deposits, although it has been reported in limited quantities in situ. About eighty per cent. of the present supply is derived from the alluvial deposits of the Ural Mountains, but there are few, if any, of the gold-bearing gravel beds of the world that have failed to yield platinum, and it is more than likely that large quantities of platinum ore have been thrown away with the black sand washings from gold placer deposits. The distribution of the ore may in fact be regarded as practically coexistent with gold placer deposits, as is evidenced by the following list of localities, excepting Russia, that have yielded the ore in varying quantities. In California, in nearly if not all of the gold-bearing gravel and sands; in Oregon, Georgia, North Carolina, Alaska, on the Yukon river, Canada, British Columbia, Mexico, Colombia and Brazil, South America, and Australia.

The genesis of native platinum is not well understood. In two cases it has been reported as found in quartz veins, but these reports have never been verified, and the theory of deposition from solution based upon them is rendered extremely doubtful by the known insolubility of the metal. The undoubted occurrences of platinum in situ are in Russia, Brazil, New South Wales, Canada and Colombia.

Platinum ore is usually found in the form of rounded or flattened grains or "sand," occasionally in irregular lumps of the size of peas; large nuggets are very rare—the largest as yet found weighing twenty-one pounds.

The ore has a metallic lustre and is distinguished by its steel gray color, shining light gray streak when rubbed on a hard white surface, high specific gravity (16 to 19) infusibility in the hottest blast furnaces and insolubility in any single acid. It is not affected by borax or salt of phosphorus before the blowpipe, except in the finely divided state, when reactions for iron and copper may be obtained. It is soluble only in hot nitro-hydrochloric acid (*Aqua Regia*).

Platinum ore is a complex body consisting of the metal in combination with varying proportions of the other members of the platinum group, such as iridium, rhodium, palladium, ruthenium and osmium, together with from four to 20 per cent. of iron. In alluvial deposits the ore is generally associated with iridosmine (a native alloy of iridium and osmium, possessing a degree of hardness superior to that of hard-tempered steel) magnetic iron sand, chromite, garnet, epidote and often with zircon, serpentine, ilmenite, peridot,

Shaft No. 2 goes to a depth of 35 feet, and it is said that diamond drill holes show 95 feet of ore to the southeast of it.

No. 3 shaft is on gold quartz, one seam appearing to be rich in free gold. A considerable amount of ore was treated in a three-stamp prospecting mill near by, and several thousand dollars worth of gold obtained[7]; so that the mine seems worthy of further development. It is to be hoped some settlement will be reached before long, so that this most interesting deposit may be put to use.

Nickel Mine at Worthington.

We walked west on the railway to Worthington to have a look at the nickel mine, now no longer working. Slate and felsite schist occur some distance east of the mine, and diabase, often rusty and gossan-like at the mine. There is no longer much to be seen on the dump. A tramway leads five miles westward from the station to the Chicago nickel mine, which however we had no time to visit, nor the gold mine a little this side of the enickl mine.

General Conclusions

Extending the area of the gold regions.

In general one notes an important advance in our gold mining regions during the past year. The area known to be auriferous has been steadily extending in the older parts of the districts, and the new Michipicoton region has been added to those previously known. A large number of properties have been under development this year, much larger than ever before; so that we may expect shortly to have the value of many hitherto problematic properties settled.

Gold Mills in operation.

The production of gold has scarcely advanced as rapidly as was expected; but some of the predictions made a year ago were unduly inflated. The number of mines actually producing gold has largely increased, there being now three mines on Lake of the Woods, one on the lower Seine, two on the upper Seine and one in the Wahnapitae region whose mills are more or less steadily at work; besides the bromo-cyanide plant successfully in operation at Deloro in the Marmora region.

Features and promises of the industry.

It must be admitted however that several of these mines are producing ore of lower grade than was anticipated, and so have disappointed their owners. Nevertheless it is probable that all of them, with ordinarily good management and reasonable economy, can produce gold at a fair profit. One mine at work last year proved to have ore of too low grade to be treated successfully by a mill of the present size. Whether capital can be raised to equip it on a sufficient scale to give a fair margin for dividends is not yet certain.

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quartz, diamond and chrysolite. Russia is the only country, excepting possibly New South Wales, that at the present time mines platinum ore for itself alone.

In the former country the platinum-bearing sand is found at depths of between six and forty feet, the "pay streak," averaging less than a foot in depth, resting directly on serpentine bed-rock. In New South Wales the "pay streak" is from 60 to 150 feet wide and underlies a loam bed 60 to 70 feet deep, the ore occuring in the crevices of the bed-rock and in the gravel resting thereon.

The method generally adopted for extracting the ore is to pass the sand and gravel with water through puddling machines or revolving conical screens; the platinum and fine sand pass through into sluice boxes beneath, while the coarser materials are discharged at one side. The contents of the sluice boxes are washed in the usual manner, and when gold is present in paying quantities it is removed by amalgamation with mercury, the platinum remaining behind. Experience shows that it is seldom profitable to work mines yielding less than three grams of platinum ore to the ton of gravel. The average yield of the richest Russian mines is about six grams per ton.

The refining of crude platinum is a difficult operation to perform and requires apparatus and experience not generally available.

As we are extensive buyers and refiners of platinum and manufacturers of the metal in all forms, we are most anxious to encourage the search for and the development of new sources of supply of the ore.

We have the best facilities for the correct assaying and refining of platinum ore and are purchasers at the highest market prices of the crude ore in either small or large quantities. We shall be pleased therefore to give additional and detailed information bearing upon this subject to such persons as are practically interested in this matter and to make tests for platinum, free of charge, on samples delivered f. o. b. at our works.

[7] Mr. B. Charlton's evidence in Rep. of Roy. Com. on the Mineral Resources of Ontario, p. 113. See also several other references to the mine.

Some of the experiences of the past year have shown how uncertain the results of a limited number of assays are in determining the value of a mine. As a rule the only satisfactory test is a mill run of as many tons of the ore as can be managed.

On the whole the conviction is being reached that in spite of a few fairly rich veins our gold ores are in general of low grade, though often present in amounts extensive enough to justify working on a very large scale. Fortunately all the properties developed except those of Marmora prove to have essentially free milling ores, so that the cost of treatment is reduced to a minimum. As roads and steamboat and railway connections improve, the cost of labor and supplies will fall; and ease of access, with a salubrious climate and safety for life and property, must give the region an advantage over most others. The presence of splendid water-powers in almost every part of our region will largely solve the question of cheap power, even if the present large supply of wood for fuel should be exhausted. It is probable that where water carriage is available the ore may profitably be taken to customs mills, like the new one at Keewatin on Lake of the Woods, particularly during the earlier stages of development, and thus prevent the risk of erecting stamp mills on properties the extent of whose ore deposits is yet unproved.

Our energies should be directed largely to lowering the expense of mining and treating the ores, now averaging perhaps not much less than $5 per ton; so that our large deposits of ore low in gold can be made to yield a profit. Some of the Alaskan mines, like the Treadwell, which in December treated 19,082 tons of ore at a profit, with an average product of only $2.37 per ton, should serve as examples in the economy of treatment on a large scale. It may be expected that immense masses of low grade ore, like some on the upper Seine and near Rat Portage, should be capable of treatment on the large scale and with as good profits as those of Alaska.

Importance of economic methods of treatment.

The Sultana mine with its new thirty stamp-mill will probably lead the way this year as in the past; but several other properties are rapidly coming to the front. While our advance in gold production has been less rapid than was expected, solid advance has been made, with the prospects of a well grounded and profitable gold mining industry in the future. That there have been some failures and will be others in years to come is only what may be expected, since this has happened in every gold region; but that the successes will be numerous and striking there is now every reason to hope.

Solid advance made.

British Association's Visit

At the close of the meeting of the British Association for the Advancement of Science, held in Toronto from August 18 to August 25, an excursion was organized to visit the Pacific coast via the Canadian Pacific Railway. One portion of the excursion, including most of the geologists and geographers, occupied a sleeping car which was dropped for one day each at Sudbury and Rat Portage, to give an opportunity to see something of the mineral resources of new Ontario. Dr. Dawson, Director of the Geological Survey, had general charge of this branch of the excursion, but the arrangement and direction of the two stops in Ontario were left to the present writer, as representing the Bureau of Mines.

Members of the British Association visit the Ontario mining districts.

A number of men of note in geological and mining circles belonged to the party, such as Professors Roberts-Austen and Le Neve Foster of the London School of Mines, Dr. Blanford, formerly Director of the Indian Geological Survey, Prince Krapotkin, Mr. Lamplugh of the British Geological Survey, and Professors Miers of Oxford, Penck of Vienna and Davis of Harvard.

The excursion was met by the mayor and prominent citizens at each place and most hospitable provision made for the comfort and interest of the guests. Short excursions were arranged at Sudbury to the well known Copper Cliff mine, to the McConnell nickel mine and to the Fairbank mine. An intended excursion to the Crystal mine was reluctantly given up because of the time required for the long drive to lake Wahnapitae and back.

All the excursionists went to the Copper Cliff mine, by far the most important nickel mine in the world; examined the ores and the interesting eruptive contact of Laurentian and Huronian; and then went to the roasting beds and the smelting works. The distinguished metallurgist, Dr. Roberts-Austen, was particularly interested in this department. Afterwards the company divided into two parties, one going to the nickel properties in Denison township; the other going by rail and carriage to the curious anthraxolite deposits of Balfour and Fairbank townships, very interesting geologically if not of great importance economically so far as at present developed. Mr. Barlow of the Canadian Geological Survey accompanied the party and furnished valuable information from the geological side. In the evening the distinguished guests were entertained at a dinner, and expressed their thanks for the hospitality shown them and their sense of the importance of the nickel and other mineral wealth of the region.

In Sudbury district.

Most of the day spent at Rat Portage was taken up with an excursion by steamboat on Lake of the Woods, the well known Sultana mine being the first object of attraction; though stops were made at several islands affording interesting geological features, such as the agglomerates and schist conglomerates of the Huronian. A short excursion was made the following morning to the eruptive contact of Huronian and Laurentian near Norman and Keewatin. The excursionists were greatly pleased with the beauty and interest of Lake of the Woods, and appreciated the importance of the gold deposits of the region.

The Lake of the Woods district.

Notes on the Petrology of Ontario

By Dr. A. P. Coleman.

THE territory covered by the Province of Ontario is so vast and the amount of work done upon its petrology so small, that, along with the necessary attention to economic mineralogy, care has been taken during our field work to obtain specimens of all rocks promising to be of interest, and to investigate their field relations as far as possible. Some of the results of the microscopic examination of thin sections made from the hand specimens taken have been made use of in the general report on the work of the summer; but much of the material accumulated has been of too technical a character to be of real value to ordinary readers of the report, interested in the economic rather than the scientific bearing of the work. As the latter appeals to a quite distinct audience it seems well to make a separate report, including from year to year the points of more purely scientific interest. Only a small portion of the scientific work done in connection with the preparation of the report on the Gold Regions of Western Ontario will receive attention in the following pages however, since much of it consisted in the determination of rocks or minerals presenting no new or specially interesting features. On the other hand, numerous rocks and associations of rocks observed having sufficient scientific importance to deserve description, are taken up in the present report, beginning at the west of the Province and working eastwards.

The Grande Presqu'ile.

Some interesting rocks of rather doubtful age occur in the Grande Presqu'ile, and as this region was not explored in the interior by Lawson, and so has barely been touched on in his account of Lake of the Woods, it will be well to take up some of the more important examples here. The first point examined was Astron bay, on the northwest side of the peninsula. A band of dark crystalline rocks extends along the western shore from the middle of Astron bay to the south end, and rocks of the same kind extend inland as far as the southern end of Beaver inlet one or two miles to the west. The commonest facies of these dark rocks has the appearance of a medium grained diorite. Under the microscope the rock is seen to consist chiefly of plagioclase (oligoclase) with very low extinction angle, and hornblende with bluegreen and yellowish brown dichroism. The latter min-

Diorite.

eral is probably secondary after augite in many cases, though no augite was found. In addition to these minerals a little quartz and some orthoclase probably occur, and small amounts of biotite, magnetite (surrounded often with leucoxene), apatite and epidote are found. The felspars show a zonal structure and tend to be idiomorphic.

Rock between Diorite and Syenite.

A somewhat gneissoid rock from a point two or three miles west of the south end of Astron bay has a very similar appearance to the previous example, but under the microscope proves to contain a considerable quantity of untwinned felspar, so as to take a place intermediate between diorite and syenite. Large masses of reddish brown titanite occur in this section.

Hornblende Porphyrite.

A remarkable rock is found at the south end of Astron bay. In a medium grained gray ground-mass there are imbedded large crystals of very cleavable black hornblende, often showing octagonal outlines. The average width of these porphyritic crystals is about half an inch. On weathered surfaces the rock has a pitted look from the more rapid weathering of the hornblende crystals. Under the microscope the ground-mass is found to consist of quartz, plagioclase, augite and probably some orthoclase. The quartz contains many fluid cavities with bubbles, and also slender trichites. The plagioclase has a small extinction angle. The augite is somewhat idiomorphic, pale greenish in color, and is to a slight degree changed to green hornblende. There are also some large prisms of apatite in the ground-mass. The phenocrysts consist generally of a single, rather homogeneous individual of hornblende having a pleochroism of yellow brown, brownish green and blue green. In the interior of such hornblende individuals there are often a few remnants of augite, not unlike the augites of the ground-mass. There is a little brown biotite mixed with the hornblende. It is probable that the large hornblendes were originally phenocrysts of augite of a first generation, more given to rearrangement than the smaller augites. The rock as a whole is perhaps best described as a hornblende porphyrite, though it commenced as an augite porphyrite.

Pyroxenite.

Two specimens of a medium grained black rock from the south end of Beaver inlet, a mile and a half west of Astron bay, contain hardly any plagioclase and consist almost wholly of hornblende and augite, with some magnetite and apatite. The freshest has the augite in about equal amount with the hornblende. In the other the augite has been entirely changed to a chloritic mineral dotted with iron oxides. It seems probable that some of the hornblende is original, as it has now and then well defined crystal forms and shows no traces of enclosed augite. In other instances the hornblende is evidently encroaching on the augite. In the freshest section there is a little brown biotite. This pyroxenite resembles the rocks previously described from the same region, with the felspars left out, but it was not observed in connection with them.

Diorite Schist or Gneiss.

Several examples were collected of a very fine grained, gray, schistose rock resembling the Couchiching as defined by Lawson on the shores of Rainy lake. A microscopic examination shows only traces of granular structure and little or no mica; otherwise their appearance is like that of Couchiching gneisses. They consist mainly of oligoclase, orthoclase and hornblende, with a considerable amount of epidote and a little quartz. One section contains many cubes of magnetite. A specimen from the outlet of lake Kashegogamog has much the same character.

Porphyrite

A handsome dark green porphyritic schist occurs at the contact of the Laurentian with the Huronian at Cross inlet, on the north side of the peninsula. The ground-mass is very fine grained and somewhat lustrous. It proves under the microscope to be made up of hornblende, chlorite, zoisite and epidote, while the large phenocrysts, though greatly weathered into zoisite, etc., have portions fresh enough to determine as plagioclase with a large extinction angle (24° to 40°) indicating bytownite or anorthite. The rock is no doubt a sheared porphyrite.

Port Coldwell Region.

A remarkable mass of eruptive rocks related to the syenites occurs on the north shore of lake Superior near Peninsula and Port Cold-

well, rising as magnificent hills immediately from the waters of the lake. A day was spent in a rapid examination of these rocks and the selection of specimens. Although some difficulties remain unsettled in respect to these rocks, a preliminary report may be made on them now.

Eruptive Rocks on the north shore of Lake Superior.

Syenitic looking rocks first show themselves at mile 808½ on the Canadian Pacific railway, about three miles east of Peninsula station. The rock here is coarse grained and almost black on fresh surfaces, but weathers to a reddish color or even to yellowish white. Four miles to the west red syenite, not quite so coarse in grain, mixes with the dark rock, probably being of later age. This variety of rock, sometimes turning gray towards Port Coldwell to the west, sends dikes into most of the other rocks of the region, and may be followed as far as Middleton (830 mile post) with some interruptions of dark, probably Huronian rock. Between Port Coldwell and Middleton the two rocks are about equal in amounts and greatly mixed. It is possible that the syenite and granite near Jackfish, 17 miles farther west, have some connection with this syenite area, though no direct connection was traced. As the Jackfish rocks have already been described in a former report[1] they will receive no further mention here.

Both the dark purplish syenitic looking rock and the red somewhat later rock are occasionally pierced with dikes of diabase, which is the latest rock of the region.

The dark rock, almost black when fresh, consists mainly of flat plates of felspar, mostly formed of two or three individuals twinned, but showing no polysynthetic twinning. The felspar strips are often a third of an inch in length and sometimes longer.

A microscopic examination shows that most of the felspar is entirely without striations, only small portions being striated, in the latter case having small extinction angles suggesting oligoclase as the felspar. Some parts of the unstriated felspar have little strips with a different extinction angle from the rest, somewhat microperthitic in appearance. In general the larger areas of felspar are not so greatly weathered as to destroy the evidence for twinning if it had ever existed. The untwinned parts, making up most of the rock, would have been looked on as undoubtedly orthoclase but for the high specific gravity (2.67). As orthoclase is nowhere stated to have a greater specific gravity than 2.58, this threw doubts on the determination, and suggested that an untwinned plagioclase was in question, the specific gravity found corresponding to that of oligoclase. A partial analysis made by Mr. W. W. Stull in the laboratory of the School of Science gave the following results:

SiO^2	65.62
Al_2O_3.....	20.32
Ca O.....	5.90

This corresponds most closely to the composition of a felspar just between albite and oligoclase.

The other essential minerals of the rock are augite and magnetite, the former making about a quarter of the whole. The augite is brown with greenish edges, though scarcely at all changed to hornblende, and is of later formation than the felspar, filling in spaces between the felspar individuals. Until a further investigation is made of the felspar the exact position of this curious rock must remain somewhat doubtful. Its structure suggests the ophitic on a very coarse scale, and, supposing the felspar to be plagioclase, the rock should be called diabase.

The red rock intimately associated with the dark rock just described has externally the character of syenite, though with considerable variations from point to point. A very characteristic specimen from the railway east of Port Coldwell is red speckled with black, and consists of what is most probably weathered orthoclase with pale sea-green augite, the latter partly turned to hornblende and magnetite. Another specimen from near by, dark red slightly flecked with black, turns out to be of an entirely different character under the microscope, showing a very pronounced pegmatite structure. Beside the intergrown quartz there is plagioclase, greatly weathered, and probably also orthoclase, with small amounts of hornblende and magnetite, probably resulting from the destruction of augite.

Augite Syenite.

[1] Bur. Mines Rep. 1895, p. 103, etc.

A somewhat fresher specimen contains very little quartz, and consists chiefly of oligoclase in more or less perfect crystals, hornblende and magnetite being the other important ingredients. An analysis of this rock was made by Mr. F. N. Speller, of the School of Science, Toronto, with the following results:

Diorite.

SiO^2	49.80
TiO^2	1.82
Al^2O_3	12.89
Fe^2O_3	18.19
FeO	.10
MnO	1.08
CaO	5.87
MgO	2.85
K^2O	.24
Na^2O	4.58
BaO	.28
H^2O	2.16
P^2O_5	.58
	99.94
Spec. grav.	2.91

The small amount of alumina and large amount of ferric oxide are very surprising, and it may be that some of the alumina was weighed with the iron.

Several examples just east of Port Coldwell are of a purplish or reddish gray color, with black crystals of hornblende. Some portions of the rock have the hornblende in long, slender crystals. Under the microscope the felspar, rather weathered, shows no twin striations, and the dark mineral is brown hornblende with a greenish border. The hornblende is only slightly dichroic, red brown and paler brown, and looks primary; but one crystal contains a core of sea-green augite, suggesting that the original dark mineral was augite. In addition to these minerals much magnetite and apatite in slender needles are found.

Syenites.

At a few points darker gray rocks are associated with the reddish syenitic looking ones, and a thin section displays a different type in which considerable oligoclase is mingled with what appears to be orthoclase, and besides the brown hornblende there is much augite, sometimes enclosed in the hornblende, sometimes quite separate from it. Parts of the hornblende individuals have well defined crystalline form and have

Augite diorite.

not at all the look of a secondary

Still other coarse grained gray ro near Pic river, show a quite different containing large scales of mica. Tw examined microscopically, and one o joins closely to the previous rock in c tion, consisting mainly of tolerably unstriated felspar with a more deca spar interpenetrating it in which n ning could be seen, and almost c augite with much brown biotite an netite.

A second thin section differs from having the felspar almost all pla

Gabbro.

Zonal structure is comm center being the more basic, in some cases from oligoclase on the to an acid labradorite within. Pale brown hornblende and brown bic about equal amounts make up the res rock. The augite and part of the hor are idiomorphic. Part of the mica unusual dichroism, orange red an green. A portion of the augite has th sions and parallel extinction found in sthene, but is not dichroic. The a augite is always surrounded with a black rims, probably of magnetite. T shows no trace of ophitic structure, spars being short and stout, and is n gabbro.

It is probable that all the rocks d from this region are genetically relat pass by gradations into one another. stand on the whole between the sy diorites and gabbros, with extremes p placed in each of these families of and intermediate members hard to cla

Two other rocks of the region are distinct. Specimens of two dark gray p

Olivine diabase.

ritic rocks east of Port Coldwe the diabase structure and be dike rocks, probably later in age t previous rocks, though this was not c proved. One of these contains man needles of apatite, sometimes with dar penetrating all the other minerals. netite in square forms and also lon strips, probably of the same mineral, a mon. Large, fresh, well shaped cry olivine are also found.

The other rock has an ophitic ground-mass of plagioclase, augite, hornblende and magnetite, the hornblende being probably secondary. In this lie very large prisms of augite and plates of plagioclase sometimes half an inch wide. This rock may be called an augite porphyrite.

Augite porphyrite.

A compact dark gray rock with a pronounced amygdaloidal structure occurs five miles west of Peninsula, a few hundred yards north of the railway. Just what its relation is to the neighboring rocks is not clear, as they were not seen in contact. The amygdules resist weathering better than the mass of the rock, and so stand up on the weathered surface. The freshest section shows a very fine grained ophitic mass in which plagioclase, magnetite and hornblende can be recognized. The amygdules have a pale rim, largely of epidote and zoisite, and a darker centre of epidote and titanite with other undetermined minerals.

Amygdaloids.

Rocks near Missanable.

A find of coal having been reported from Missanabie, north of Michipicoton where gold has since been discovered, the rocks in the neighborhood of that station were studied. The most interesting are certain diabase dikes in phyllite and mica schist. The supposed coal turns out to be a basic eruptive glass, black and vitreous in look. It proved impossible to make a section of it thin enough to be transparent. This glass forms the thinnest ends of branching dikes, or the edge of somewhat larger dikes, having a thickness seldom greater than half an inch.

Diabase dikes in schist.

Immediately against the glass the rock is exceedingly fine grained, as might be expected, and very opaque. Clear stripe of plagioclase are embedded in an obscure groundmass, perhaps devitrified glass, containing many black dendritic formations, probably of magnetite.

A little farther away one finds typical diabase, consisting of plagioclase strips in augite with some magnetite.

The glassy diabases are two or three miles west of the station. A short distance east of the station coarser diabase is seen in a cutting. Except for a small quantity of quartz it is very like the previous rock, and is of interest mainly from its habit of weathering into brown spherical masses.

The Wahnapitae Region.

A number of rock specimens collected by Dr. Bell from the Sudbury and adjoining regions were examined microscopically by the late Prof. George H. Williams, his results being published in an appendix to Dr. Bell's report on the Sudbury district,[2] and a few rocks from the Clear Lake region northwest of Sudbury were described by the present writer in 1893,[3] but in general the region has received little study from the petrographic side; so that it may be of use to describe some of the more important rocks collected last summer on or near lake Wahnapitae.

The eruptives examined are chiefly diabases and related rocks. A dike two feet wide on location WD66 is dark gray, fresh looking and somewhat porphyritic. Under the microscope it shows a typical ophitic structure, brown or purplish augite filling spaces between clean cut strips of rather basic plagioclase. A number of rather large olivine crystals occur, and there is much magnetite enclosed in other minerals. The adjoining country rock of a gold bearing vein is comparatively coarse grained, and proves under the microscope to be a badly weathered quartz diabase in which most of the felspar is changed to saussurite and the augite to hornblende with a little biotite.

Olivine diabase.

A very similar but fresher rock occurs near a hill of arkose on lake Kookagaming two or three miles to the west, with less quartz however. The plagioclase is labradorite and is not always in slender strips, but sometimes in stout crystals, so that the structure is about midway between the ophitic and the granitic.

A greatly weathered quartz diabase is found at the portage east from the Crystal mine, the quartz forming a rather coarse pegmatite structure with the felspar and filling in spaces as the last mineral to soldify. Most of the augite has been transformed to hornblende.

[2] Geol. Sur. Can., 1890-91, pp. 55, etc., Part F.
[3] Can. Rec. Science, April, 1893, pp. 343-6.

A reddish gray rock at the Crystal mine just east of lake Wahnapitae contains a very large amount of quartz, mostly arranged in a roughly "graphic" way. The felspar, about equal in amount, is so far weathered as to make identification uncertain. Some of it appears to be plagioclase. Much of it has distinct crystal form. A small amount of green biotite and some chlorite occur also. The rock is no doubt a plagioclase granite or quartz diorite.

Granite.

A very interesting group of clastic rocks is found in the Wahnapitae region, including quartzites, arkoses, graywackes and impure dolomites. Several of the arkoses are quite granitic in general appearance, flesh red and massive looking; others approach the quartzites. Several outcrops of arkose were examined. One of them, from the Sheppard gold mine on the south shore of lake Wahnapitae, has been described by Prof. G. H. Williams,[4] who refers to it as a felspathic sandstone or quartzite, in which "angular or subangular quartz grains that have undergone some secondary enlargement, are mingled with felspar which is changing, though it has not yet entirely changed to a sericitic ground-mass." Some of my sections show less change, perhaps being from fresher hand specimens. The quartz grains are usually fairly well rounded and little, if at all enlarged, while the felspar present in about an equal amount is granular also, and though somewhat weathered is distinctly recognizable as orthoclase, microcline and oligoclase. Except secondary sericite, no other mineral can be distinguished. The specimens just described come from the shore.

Arkoses.

Specimens taken from the small workings on the brow of a hill one or two hundred yards inland are different in character, being more granitic in look and containing well formed crystals of arsenopyrite, simple and twinned. A section made from one specimen might easily be taken for a granite. With crossed nicols there is hardly a trace of granular structure, the whole section being formed of interlocking minerals, but the general appearance suggests somewhat the mortar structure, larger individuals being sometimes surrounded by a fine mosaic of small quartz and orthoclase individuals. Close examination shows however that many of the larger masses have been enlarged with fresher materials of the same kind. The fresh extensions of plagioclase tend to have wider twin lamellæ than the original mineral, though alike in extinction angle; and these extensions sometimes show a zigzag edge, each twin lamella appearing to end independently of its neighbors. This is observed only where the felspar abuts upon an area of clear quartz. There is much secondary muscovite present and a small amount of some carbonate. Prisms of rutile also occur.

It is probable that my sections present the two extremes of little modified and greatly modified arkose, while Williams' section stood midway between.

Thin sections from a high hill on the southwest side of lake Kooksgaming show well rounded quartz grains and a few tolerably clear grains of microcline in a sort of groundmass of decaying felspar.

The graywackes are of considerable variety, running from compact flinty or slaty rocks to conglomerates. Some of them might easily be taken for compact massive rocks, but for the occasional pebbles of a similar gray color or more rarely of a red granitic rock which they contain.

Gray-wackes.

Under the microscope they are seen to consist of a very fine paste of clayey or silicious material with angular fragments of quartz, or of rocks of various kinds, the latter often more recognizable with the naked eye than under the microscope. The granitic looking pebbles are sometimes quite large and are very prominent from their different color. A section of one such pebble proves to be of weathered plagioclase granite or quartz diorite.

There are all transitions between the slaty rocks and graywackes and dolomites, the latter usually containing many angular fragments of quartz as well as chlorite and other secondary minerals. Frequently well formed rhombohedra of dolomite lie in a confused ground-mass of dolomitic and argillaceous material.

Dolomites.

[4] Appendix to Dr. Bell's Rep., No. 28, p. 69 F.

Clastic Huronian Rocks of Western Ontario

By Dr. A. P. Coleman.

Introduction

E ROCKS of western Ontario have been more or less carefully examined by several geologists, such as Bigsby, ınd Dawson, but the first detailed ng of the region was done in 1883 and ding years by A. C. Lawson, who laid ellent foundation for the future study of the Lake of the Woods and Rainy Lake districts[1] Since then adjoining districts have been mapped by C. Smith and W. McInnes, and special ns have been studied by H. L. Smyth, ıell and Grant, and the present writer. ɔneral conclusions reached by Lawson ɔeen commonly accepted by those who ollowed and will be made use of largely present paper, though most of the ɔmployed have been observed by the while engaged in field work for the u of Mines.

ɔson describes the region as wholly an, and divides the rocks into two parts—a lower one, the Laurentian, and an upper one, the Ontarian, further subdivided into the Couchiand the Keewatin. The term Laurenused here in a petrographic sense, to ɔ a series of entirely crystalline, generɔcid rocks, especially coarse grained es and granites, in spite of the fact ıese rocks have an eruptive contact he overlying series, and so are later in an the Ontarian.

Couchiching rocks, found chiefly in ıthern portion of the region along the ary of Minnesota, consist in general of ɔnous gray or brown mica-schists and es, sedimentary in origin.

The Keewatin, which overlies the Couchiching where the latter is present and in other cases rests on the Laurentian, is largely composed of eruptives and their products—schists resulting from shearing, ash rocks, and agglomerates—basic in the lower part, acid in the upper[2]

Lawson does not definitely correlate the Couchiching with either the Laurentian or Huronian, but Van Hise includes at least part of it in the Basement Complex[3]. Lawson puts the Keewatin doubtfully with the Huronian, pointing out numerous differences between it and the original Huronian as described by Logan. In general however Canadian geologists do not hesitate to class these altered eruptives and the accompanying sedimentary rocks as Huronian, and this usage will be followed in the present paper.

In the first place the Huronian clastics will be briefly described, and afterwards the relations subsisting between the series of rocks and their causes will be discussed. The term Archean will be used to include both Laurentian and Huronian (or Ontarian), though according to the classification adopted by the United States Geological Survey the latter would be included in the Algonkian.

Huronian Clastics

As to origin, the Archean clastic rocks of western Ontario are of three kinds—pyroclastics, autoclastics, and sedimentary rocks proper.

Pyroclastic rocks

The pyroclastics, consisting of agglomerates, ash rocks, etcetera, are of great extent and importance, but have no special bearing on the subjects of this paper, and so need no extended description.

[1] Sur. Canada, 1885, p CC; and 1887, p F.

[2] Geol. Sur. of Can., 1887, p. 22, F., etc.

[3] Principles of pre-Cambrian Geology, p. 782.

It is probable that some rocks mapped as agglomerates are really autoclastic, especially those including fragments sharply angular in form and all of the same kind. These angular blocks of rock could hardly have been hurled into the air as bombs. Lawson mentions transitions between agglomerates and true conglomerates with waterworn pebbles, which might readily occur where volcanic materials drop into the sea.

Autoclastic rocks.

The autoclastics are not very extensive and will merely be mentioned. They are produced by the action of crushing and shearing forces in rocks above the level where pressure produces plasticity, and so give a hint as to the original depth of the rock beneath the surface. The best examples known to me, omitting the eruptives already mentioned, are the limestone breccias of Steep Rock lake and certain conglomerates to be seen a mile west of Fort Frances, where in the sharp folding of thin beds of sandstone between layers of schist the latter has yielded plastically, while the former was broken to fragments now embedded as pebbles in the schist.

Ordinary clastics.

The ordinary clastics, true sediments, are of special interest as giving clear ideas of the conditions of the time, and so will be described more at length than the two previous groups. The Keewatin, though very largely of eruptive origin, contains important sedimentary members, and the Couchiching is wholly sedimentary.

Keewatin Rocks.

Water-formed clastics. Limestones.

The water-formed clastics of the Keewatin are of great variety, including limestones, slates, quartzites, grits, graywackes, breccias, and pebble and boulder conglomerates. The limestones are however of limited extent, being found in any thickness only at Steep Rock lake, 70 miles east of Rainy lake, where there is a small area differing both petrographically and structurally from the rest of the region. These limestones have a very modern look, being scarcely at all crystalline in appearance, having cherty layers in gray limestone at some points and black, very carbonaceous beds at others. One almost expects to discover fossils in them, but none have been found. They have been folded in an extraordinary way into an anticline and syncline having their axis inclined 60° or more.[4]

Slates.

The slates are widespread, passing often into phyllites. Many of them contain carbonaceous matter, and some examples have a graphitic look and soil the fingers. One of them, from an analysis by Dr. Adams, was found to contain 7.44 per cent. of carbon, and is porous as though hydrocarbons had volatilized leaving round cavities.[5] These carbonaceous slates may be compared with the black slate of the Sudbury region, in which Dr. Ellis has found 6.8 per cent. of carbon, and which was at one time bituminous, as shown in Balfour township by a large vein of anthraxolite, once no doubt a fluid or plastic petroleum product.[6]

Graywackes and Conglomerates.

The widespread graywackes need only be mentioned, since they present no points of special interest, and the same may be said of the somewhat unusual quartzites and grits, but the conglomerates are of more importance. They are found in many localities, but only one example will be taken for description, that of Shoal lake, more thoroughly studied than the others because occurring close to a number of gold-bearing veins. As seen on the shore of the lake, it is a schist-conglomerate consisting of green chlorite as a matrix, with well rounded pebbles of all sizes up to two feet in diameter embedded in it. That this portion of the conglomerate has undergone shearing is shown by the flattening and even tailing out of some of the softer pebbles, and the breaking and shifting of the parts of some of the harder ones. The commonest rock species in the pebbles are quartz-porphyry and porphyrite, felsite and green schists indistinguishable from adjoining Keewatin schists. In addition, there are fragments of black and red quartzite and of white, pulverulent sandstone, of vein quartz and of anorthosite. No gneiss or granite has been found after careful search, though some

[4] H. L. Smyth, Geology of Steep Rock lake. Am. Jour. Sci., vol. xlii, 1891, pp. 317-331.

[5] Geol. Survey of Canada, 1885, pp 58, 124 and 150, CC.

[6] Ontario Bureau of Mines Report, 1896, p. 159, etcetera.

z-porphyries having the crystals of fel-
nd dihexahedra of quartz much crowded,
ıt first glance very like granite. Most
ıse pebbles are easily matched by Kee-
rocks, sometimes however many miles
ıt; a few are evidently Couchiching,
ıone are Laurentian. One rock, a quartz-
ıyry, half made up of beautiful spheru-
ıaving feathery intergrowths of quartz
elspar, has not hitherto been recognized
ıtario.

o or three miles north of Shoal lake and
distance across the strike the rock
nes much less schistose, has a coarse
ıs matrix, and might almost be described
breccia, since many of the pebbles are
ely rounded. The pebbles are however
e same rock species as those on the shore
e lake.

ıis band of conglomerate is at least 16
ı long and two miles wide. Its thick-
can hardly be less than a mile, and may
most double that, since the dip is steep;
ı covering of sand prevents very accurate
urements of the width. A very similar
lomerate appears on the east shore of
er Manitou lake, 50 miles to the north,
ıining porphyry, felsite, quartzite, etce-
and a fine example is found at Rat Por-
the matrix in this case however being
itic instead of chloritic. Numerous other
ınces are found in various parts of the re-
. No pebbles which are undoubtedly
entian have been reported from any of
ı, though granite boulders are found, as,
ıxample, near Abram's rapids, north of
Minnetakie. They resemble closely erup-
granites piercing the Keewatin in neigh-
ng localities, and differ in appearance from
characteristic granite of the Lauren-

Couchiching Rocks.

he Couchiching rocks are all formed of
l, or clayey sand more or less metamor-
phosed. The least changed were
found by the writer on the shore of
Rainy river a mile below Fort Fran-
and at the Scramble mine near Rat Por-
ı. They form thin beds of yellowish or
wnish soft sandstone lying between mica-
ıs and chloritic schists. Under the micro-
scope, besides grains of quartz, there are particles of magnetite and numerous small prisms, probably of tremolite. In general however the Couchiching consists of biotite schist or gneiss, the quartz showing a clastic origin. Some of these schists contain sillimanite; more rarely they appear as thoroughly crystalline gneiss containing muscovite, microcline, etc., resembling the adjoining Laurentian and forming transitions towards it.

osition uchich- cks.

The Couchiching includes no coarse clastics, and is nowhere separated from the underlying Laurentian by a basal conglomerate. These rocks have been mapped by Lawson, Smith and McInnes as covering extensive areas in the southern part of the region. Rocks of a similar kind occur on Manitou lake, near Lake of the Woods and at other points, but have not being separated in the mapping.

Relation of the two Classes.

Lawson suggests that the Shoal Lake and other conglomerates represent the base of the Keewatin, and so indicate an unconformity between the Keewatin and the Couchiching;[7] but the finding of many Keewatin pebbles in the conglomerates opposes this view. A striking evidence that the break represented by these conglomerates comes high up in the Keewatin instead of at its base just above the Couchiching is to be found at Shoal lake, where a few boulders of coarse-grained anorthosite found in the schist conglomerate are exactly like portions of a boss of anorthosite two miles away. As this anorthosite area contains masses and strips of characteristic Keewatin schist swept off during its eruption, it is evident that an immense lapse of time separates the conglomerate and the underlying Keewatin, long enough for a coarse-grained plutonic rock to solidify, probably at considerable depths, and then for the region to be so profoundly eroded as to provide pebbles of the plutonic rock on a seashore. It is probable that the Keewatin conglomerates which have been referred to represent an important interval of erosion, perhaps equivalent to the

Evidence of unconformity.

[7] Geol. Survey of Canada, 1887, p. 84, F.

one shown to exist by Van Hise and others between the upper and lower Huronian in the States to the south.[8]

Nevertheless the striking difference in the character of the rocks of the two series, wholly sandy sediments in the Couchiching, largely diabase and porphyry and the products of their alteration in the Keewatin, shows that conditions have greatly changed before the later series was formed.

It must not be assumed of course that all of the eruptives found in the Keewatin were surface flows of the same age as the enclosing rocks. Many of them are probably of the nature of laccolitic sills like the trap sheets in the Animikie near Thunder bay. In fact, but for the undoubted pyroclastic rocks among the sediments, one might suspect that most of them were injected between the sedimentary beds perhaps at a much later date, since no amygdaloidal varieties have been found. In a region where there has been so much folding and shearing it is rash to make positive statements on such matters, however.

Lawson estimates the thickness of the Keewatin at about five miles,[9] and of the Couchiching at about the same ;[10] but W. H. C. Smith suggests for the latter that there may be a number of closely oppressed folds not easily separated, so that the thickness of the Couchiching may be very much less, though still reaching 8,000 to 9,000 feet.[11]

Evidence of Compression

Following Lawson's estimate, the two series together sum up to 50,000 or more feet in thickness, though it is probable that the lowest beds of the Couchiching have been dissolved by the molten Laurentian rocks beneath, since no basal conglomerate has been found ; and also that there has been a considerable amount of compression during the squeezing undergone in the sharp synclinal folds, as proved by the flattening of soft pebbles in the conglomerates.

The Couchiching, containing some little consolidated sandstones, can scarcely be included in the Laurentian ; and as it forms transitions to rocks recognized as Ke and lies conformably so far as obser neath the latter, there seems no reas the two together should not be cla Huronian.

The Huronian of western Ontario p then, an immense series of shallo sediments, in the upper part mixe eruptives, perhaps largely later inj but partly pyroclastic ; the whole e magnitude to the thick series of clastic in the preparatory troughs of great m ranges, such as the Appalachians a Rockies.

Laurentian and Huronian.

The field relations of the Laur Couchiching and Keewatin have been mirably shown by Lawson th a brief summary will be re here. He was struck by t that the lower Archean "occurs in isolated, central areas more or less con ly surrounded by the schists of the Archean, the encircling belts anasto and forming a continuous meshwork."

Field relations of the two great series

An examination of the Rainy Lake r where the innumerable bare shores of i and promontories give an unsurpassed ure of the Archean, shows that the L tian consists chiefly of coarse reddish, porphyritic rock, usually granite in th tral part of the area, but showing fo towards the margin where it comes in c with the Huronian. The foliation gneiss is generally parallel to that schist beside it. Before the actual con reached one generally sees strips an ments of the Huronian embedded i gneiss, sometimes sharply angular, at with softened outlines. Often the actu of contact is hard to define, so mixed a gneiss and the schist. Dikes of gr pegmatite or felsite generally run fro gneiss into the Huronian. Where the is Keewatin one usually finds it hardene hornblende-schist instead of the mor mon chlorite-schist. The Couchiching shows much contact metamorphism, t occasionally garnets and staurolites are oped.

[8] Journal of Geology, vol. i, No. 2, p. 120.

[9] Geol. Survey of Canada, 1887, p. 55, F.

[10] Ibid., pp. 101 and 102, F.

[11] Ibid, 1890—'91, pp. 54 and 55, G

[12] Geol. Survey of Canada, 1887, p. 142,

The Huronian schists have almost always a steep dip away from the gneiss, seldom less than 45° and often verticle, and are folded into sharp synclines.

Areas of Laurentian

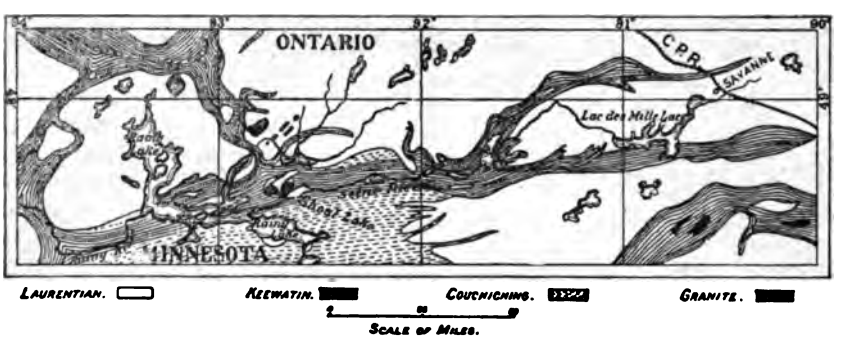
The areas of Laurentian are of all dimensions from a mile or less in diameter to a width of 50 miles or perhaps even more, and are usually rounded in form. Good examples of the larger Laurentian areas are found in the one including the north arm of Rainy lake, nearly 50 miles long from east to west and 25 wide; and in the Grande Presqu'ile of Lake of the Woods, 30 miles in length from east to west and 18 wide. Of the smaller areas mention may be made of Sultana island a few miles from Rat Portage, famous for its gold mine. Here a boss of coarse prophyritic granitoid gneiss a mile in length by half a mile in width presents the same eruptive contact with the green Keewatin rocks as one finds around the larger masses. Another similar boss of coarse Laurentian granite was found by the writer at Caribou lake, east of the lower end of lake Manitou, the area being only about a square mile. Examples of intermediate sizes may be found on the Canadian Geological Survey's maps of the region.

Finer grained granites, generally showing no foliation on the edges of the areas, are common also both in Huronian strips and in the Laurentian; and many more small knobs and bosses than were mapped by Lawson in his somewhat hurried work will be found from time to time, such as the area of protogine containing so many gold-bearing veins at Shoal lake. So far as known, these granite bosses are later than both Keewatin and Laurentian, having penetrated both. It is however not always easy to say whether a given rock is Laurentian or a later granite, and it is likely that the two are connected in origin and might be arranged as a consecutive series. Both Laurentian and other granites send off felsitic dikes into the adjoining rock, and in this way one may often discover the proximity of a gneiss or granite area a quarter of a mile before reaching the contact.

It is worthy of note, as observed by Lawson, that often the gneiss grows darker and more basic near the contact with basic Huronian rocks, as though some of the latter material had been incorporated in the underlying Laurentian.

Map showing the rock relationships

The accompanying map will illustrate the geological relationships just mentioned. It has been pantographed from three map sheets issued by the Canadian Geological Survey—the Rainy Lake, Seine River, and Shebandowan sheets—the work of Lawson, McInnes and Smith. As the scale is small and the lake and river systems are complicated, it seemed wise to omit much of the topography so as not to confuse the geological boundaries. The portion mapped includes on its western side one of the most characteristic batholitic areas, though tracts to the north and west would serve equally well as illustrations if the geological sheets covering them had been published.



Geological Map of part of Western Ontario.

Only a few of the granite bosses are mapped, many being too small to be conveniently shown.

Evidently this well glaciated Archean peneplain presents a most instructive section

through the base of an ancient group of mountains. The sharp synclines of Couchiching and Keewatin nipped in between areas of gneiss and granite are merely remnants preserved because of their protected position. Often unfinished curves may be seen running out into the Laurentian, erosion having eaten below the bottom of the part that has vanished. Imagining these roughly circular or oval synclinal folds complete, we should see convex surfaces forming domes of diameters varying from one mile to 50 miles. What their height was in their prime one can hardly guess ; but from their diameter and the steep dip of their synclinal portions one may suppose that the largest of these pre Cambrian mountains were comparable with the greatest mountains of the present day.

Sections through Pre-Cambrian Mountains.

The process by which they were built seems to have differed from that of later times in the earth's history, since they were not constructed of a series of parallel anticlinal folds, but were pushed up more like the laccolitic mountains described by Gilbert and Whitman Cross from the western United States, though with the difference that the up-pushing mass of molten rock was broad based.

While the larger areas of gneiss and granite are evidently batholites, some of the smaller granite bosses may be stumps of old volcanoes, though they could not have furnished the acid pyroclastics of the Keewatin through which they rise. Lawson looks on the Shoal Lake anorthosite boss as the stump of a volcano furnishing basic pyroclastics.[13]

Rock History of the Region

Reviewing the facts presented by the rocks of western Ontario, we find an oldest series, the Couchiching, consisting of sands and clayey sands deposited on a sea bottom, since entirely destroyed. The adjoining land must have presented an abundance of quartz-bearing rocks to furnish so many cubic miles of sand. After at least a mile and a half and probably five miles thickness of these sands had been laid down in the southern part of the region, the second or Keewatin series began, in which great eruptions of basic and acid rocks alternate with clays, grits, and conglomerates, the latter sometimes a mile thick. It is probable that an important break in the series is shown by the conglomerates. During the later part, if not the whole of the time we may suppose that organisms existed, furnishing the large percentage of carbon found in some of the rocks. Ultimately the sinking sea bottom was loaded with an eight or ten miles thickness of sediments and eruptive materials, as in the geosynclines preparing the way for later mountain ranges, and the slowly rising isogeotherms softened or fused the foundation, which rose into domes, the inner parts solidifying as granite, the outer more viscid portions having their constituents dragged into rough parallelism with the adjoining solid rocks and forming gneiss.

Great thickness of the formations.

Comparison with other Regions.

The usual theory of mountain-building, by lateral thrust due to the sinking in of the earth's crust to conform to the shrinkage of the interior through loss of heat or of volatile constituents, seems capable of producing only folds ; and it is doubtful if thrusts in two directions at right angles to each other could produce anything except more complex forms of the same kind. The formation of irregularly placed domes demands some other cause.

Batholites and Laccolites

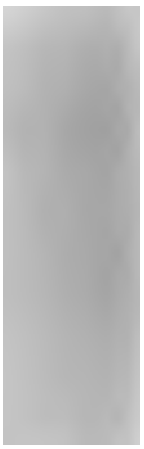
One naturally compares these batholitic[14] mountains with the laccolites so distinctly brought before the world by Gilbert in his description of the Henry mountains of Colorado. There also there are oval domes, though not over three or four miles in diameter. Larger but more irregular ones are described by Whitman Cross from the adjoining western States. It is evident however that these cake-like masses of eruptive rock resting on their undisturbed floor of stratified rock differ greatly from the Rainy Lake mountain stumps, which are only more elevated portions of the general substratum of gneiss on which the sedimentary rocks now rest.

[13] Geol. Sur. of Canada, 1887, p. 57, F.

[14] Bathylite is the form of the word preferred by Dana and Zirkel.

C. P. R. bridge across Magpie River, Tote-road bridge in the foreground. Photograph by Willmott.

Rapid on the Magpie River, about 25 miles from its mouth. Photograph by Willmott.



View on the Magpie River. Photograph by Miller.

Gorge at second portage up the Magpie River. Photograph by Willmott.

Falls at mouth of Magpie River. Photograph by Miller.

Second Falls on Magpie River. Photograph by Miller.

Sand beach at lower end of Hawk Lake, at the efflux of Hawk River. Photograph by Miller.

Wawa Landing on Michipicoton River. Photograph by Willmott.

The eruptive masses described by Dawson from the Sweet Grass hills of northern Montana, tilting up "the previously horizontal beds of the plains,' so that those immediately surrounding the igneous masses rest at very high angles,[15] seem more nearly related in general structure, and the same may perhaps be said of the extraordinary "plutonic plugs" described by I. C. Russell as pushing up the strata into domes in the Black Hills of Dakota.[16] Probably some of the bosses of granite described in works on geology are of the same character, though many of them have a different relationship, pushing or fusing their way through overlying strata without becoming schistose themselves nor doming up the beds above.

The dome of the Black Hills, as represented by Russell[17] seems to come closest to the batholitic domes of western Ontario, though the section across the Black Hills, copied from Newton and Gilbert, differs greatly from them in some points. As shown diagrammatically, the relatively small central plug of granite is surrounded by a wide band of vertical schist, on whose edges rests the dome of sedimentary rocks, as though there had been two upheavals, separated by a wide interval, during which the later sediments of the dome were deposited. The size of the Black Hills dome is greater than that of the west Ontario batholites studied up to the present, and the time of the latest uplift much more recent.

Gilbert suggests for the laccolites that the ascending flow of molten rock rises only until the overlying rock is less dense than itself, when the latter is pushed up into a dome, the general law of hydrostatics being obeyed.[18] Whitman Cross, following Dana, does not accept the hydrostatic theory, thinking that the force which set the lava in motion is sufficient to account for the facts.[19] I. C. Russell suggests "that uplifts which owe their origin to the intrusion of a molten magma into the rocks beneath them be termed subtuberant mountains. They may be fancied to originate from the growth of a tuber within the earth's crust."[20] He thinks that the cooling and therefore contracting crust of the earth brings pressure to bear on the hotter interior, squeezing upward the molten rock, which may either form domes without reaching the surface or come to the surface forming volcanoes.[21] Suess thinks that eruptives of this sort cannot elevate the rocks above, but, on the contrary, can only occupy spaces already prepared by tensions in the earth's crust.[22]

Cause of these Mountain structures.

Some of the methods referred to are obviously inapplicable to the batholitic type of mountains. Russell's suggestion of upwelling lavas urged by squeezing action of the earth's crust can hardly be brought to bear on a region where the whole solid crust for thousands of square miles has been tossed into irregular domes. In fact it is difficult to see how any outside force can be applied in such a way as to elevate domes 50 miles across when the earth's crust adjoining is itself plastic. We seem compelled to look for some force inherent in the masses themselves. If we look at the conditions we find that the granites of these batholites were probably fused hydrothermally, but not excessively hot, since blocks of basic Huronian rock, readily fused by a dry heat too low to melt granite, often lie in them with unrounded edges. Even at a relatively low fusion point they must have been much hotter and hence (potentially) lighter than the unfused rock above, particularly when the latter was basic like most members of the Keewatin series. This relatively light silicious magma, probably not thoroughly liquid, but only plastic following the laws of hydrostatics crept upward where the load of overlying rock was smallest, the heavier Huronian beds meanwhile set-

Objections to the theories of origin.

[15] Geol. Sur. of Canada, 1882-'83-'84, p. 17, C.

[16] Journal of Geol., vol. iv, no. 1, p. 23, etc.

[17] Journal of Geology, vol. iv, No. 2, p. 183, etcetera. I have been unable to obtain a copy of the "Geology of the Black Hills" in time for use in preparing this paper.

[18] Geology of the Henry Mountains, Washington, 1877, pp. 72 and 95.

[19] Laccolitic mountain groups of Colorado, Utah, and Arizona-Washington, 1895, p. 241.

[20] Journal of Geology, vol. iv, No. 2, p. 189.

[21] Ibid, pp. 190, 191.

[22] Antlitz der Erde, vol. 1, p. 218, etc.

tling slowly into synclines between the rising batholites. The process may be conceived to have gone on very slowly under sufficient load to prevent violent disruptions of the overlying strata, since a certain plasticity of the beds is shown by the shearing observed, especially among the softer pebbles of the conglomerates.

The large porphyritic felspars observed in many of the gneisses and granites suggest two stages in the history of these rocks—an earlier one, before the ascent began, and the later slow consolidation. Augengneiss around the margin of batholites proves that the crystals existed before the shearing uprise was complete.

Some of the laccolites described by Gilbert show suprisingly perfect unbroken domes of stratified rock, and the same is true of the domes elevated by plutonic plugs; in both cases due, as suggested by Gilbert, to there having been load enough to prevent disruption. The amount of stretching undergone by the arched strata in the instances described was however not very great.

In the case of the larger batholitic domes of western Ontario the extension must have been as a rule much greater. The Grand Presqu'ile dome may have been comparatively low and flat, since a dip of only 24° may be observed in Huronion schist resting on gneiss at the south of the batholite, and basic schistose rocks found in its interior west of Astron bay are perhaps remnants of the upper parts of the low arch of the dome.

In other cases where the dip of the schist is very steep or sometimes even tilted a little under the edge of the batholite, it is probable that the dome was much higher, and the stretching of the overlying strata must have amounted even to miles in large domes like that of Rainy lake.

Extent of the Batholitic Region.

The region whose geological history has just been sketched extends from Lake of the Woods on the west to Lac des Mille Lacs on the east, a distance of more than 200 miles, with a width north of Rainy lake of 120 miles. Most of this large extent of country shows the mesh structure in a more or less typical way, though

In North-Western Ontario.

toward Lac des Mille Lacs on the ea bands of Huronian tend to become pa suggesting an approach to the more r folded mountain structure. Througho whole region the Laurentian has er contacts with the Huronian, and nothi a basal conglomerate of the Huronian c found.[23]

It would be unwarranted perhaps t gest that the relationships described ar mal for the Archean, especially when ively only a small portion of the im extent of the Canadian Archean has mapped with any detail, yet in a consid number of instances similar relationship been found.

Dowling maps imperfect mesh-like of Huronian about areas of eruptive g and granite from the distri Keewatin,[24] 80 miles north of of the Woods, and Barlow states th underlying gneiss has an eruptive co with the Huronian in the Sudbury r 500 miles to the east of Lac des Mills Dr. Bell however appears to differ from view, explaining the relation of the two s of rocks, at Wahnapitae for instance, b suming a fault.[25] My own observations Sudbury and Wahnapitae convince me at those points the contact is eruptive, dikes of pegmatite, etc., may be seen pa from the gneiss into the green Hur rocks. The loops so characteristic o Huronian further west are however t seen only indistinctly, if at all, on Bell's of the region. Adams and Barlow show

In Northern Ontario.

[23] Van Hise (Pre-Cambrian Geology, p. follows Symth in speaking of the Steep Rock series as resting with a characteristic basa glomerate on the eroded edges of the Base Complex; but my own observations show t be no exception to the general rule. The gne granites which enclose the series form eru contacts with the Keewatin at the Harold gold mine a few miles west of Steep Rock and Smyth himself (Am. Jour. Sci., vol. xlii, p. 322) in describing the supposed basal con erate states that it contains large pebbles of q and greenstone, but mentions no gneiss or gr pebbles.

[24] Geol. Survey of Canada, 1894, part F.

[25] Ibid, 1890-'91, p. 14 F.

relationships between the Hastings and
ern Grenville series of eastern Ontario
and the underlying Ottawa gneiss.[26]
dams maps similar curving bands of
renville crystalline limestones sinking
he gneisses below, in his report on the
ntian area north of the island of Mont-
These two series are probably the
n equivalents of the western Huronian,
renville series having undergone a more
ie metamorphism than the usual Huron-
The conglomerates found by Adams
that these rocks were undoubtedly of
entary origin.

l farther east, in the great Labrador
sula, Lowe describes crystalline lime-
stones and garnetiferous graphitic
or gneisses forming bands in the Lau-
la. rentian, though his evidence as to
lation of the ordinary Huronian to the
lying Laurentian is not so conclusive.
cognizes in some of the mica-gneisses
entary beds like Lawson's Rainy Lake
iching, but in other places speaks of
nian rocks as resting unconformably on
aurentian, though in some cases they
ore or less interfolded with the Lauren-
[28]

the other hand, according to Van Hise,
n's original Huronian, north of the lake
an's from which it got its name, seems
l to be of later age than the underly-
ian. ing Laurentian, since he finds basal
omerates or breccias containing frag-
s of Laurentian rock at two localities.[29]
ow, who has examined the same region,
s however that there also the contact
ptive.

om Van Hise's admirable "Principles of
h American pre-Cambrian Geology" one
that a conglomerate of the Huronian
discordantly on the foliated edges of the
l Complex at many points south of lake
rior,[30] and Dr. Dawson informs me that
cteristic Huronian beds rest on an erod-
aurentian surface in New Brunswick.

It may be that at more southerly points the thickness of the Huronian series is con-
The need for more careful study noted siderably less than in the typical Archean region, and hence that the floor on which the sediments rested was not softened or fused, as happened farther north. On the other hand, it is not impossible that in the states south of the lakes rocks of a somewhat later age, resting on the upturned edges of the Archean (including the Rainy Lake Huronian) have been looked on as Huronian. Van Hise includes mica-schists, green schists, etc., of Lawson in the Basement Complex on whose eroded edges the Huronian is supposed to rest.[31] As it seems generally assumed that distinctly clastic rocks, such as the little altered Couchiching sandstone of Rainy river, should not be referred to the Laurentian, it might be well for a small party of American and Canadian geologists interested in these questions to go over certain typical regions together, so as to come to a common basis of classification for these difficult formations.

However it may be in other regions, there is certainly a very large area in northwest Ontario in which the relations between batholites of granite and gneiss and the schistose rocks of Huronian (Ontarian or Algonkian) age are as described in the present paper. Tens of thousands, if not hundreds of thousands, of square miles of the western Huronian were once afloat on a plastic granitic magma which swelled into great bubble-like mounds, while the colder surface rocks tended to sink into the spaces between; and a phenomenon of such wide extent deserves careful study, whether the explanation given above be correct or not.

It is worthy of note that in several regions where ancient sediments were supposed to rest discordantly on the Fundamental Complex more detailed study has proved that the contact is eruptive. The latest instance is described by R. A. Daly, who finds batholitic gneiss pushing through overlying mica-schist in New Hampshire.[32]

It is probable that wherever sediments accumulate to a thickness of 40,000 to 50,000

[6] Am. Jour. Sci., vol. iii, March 1897.
[7] Geol. Survey of Canada, 1895, part J.
[8] Geol. Survey of Canada, 1895, part L., p. etc.
[9] N. Am. Pre-Cambrian, 1896, p. 777.
[0] Ibid., p. 784.

[31] Pre-Cambrian Geology, p. 782.
[32] Journal of Geology, vol. v, No. 7, p. 694, etc

feet the beds on which they lie become plastic if not fused, shift their place to correspond to the load, and form eruptive contacts with the rocks above. As this has taken place beneath every great mountain range, perhaps aided by relief from pressure under anticlines, and is no doubt still taking place where preparations are being made for the great mountain chains of the future, a so-called Fundamental Complex is to be regarded, not as characteristic of great antiquity, but as resulting from a certain set of conditions which may exist at any age. The older mountain ranges, having been more deeply eroded, give an opportunity to study these gneissic and granitic cores, while in later ranges they are still buried out of sight. It is likely however that a basal section through our present mountain ranges would show long bands of gneiss and granite rather than approximately circular batholites, such as we find in western Ontario.

A probable cause of eruptive contacts.

If the supposition just made be correct, areas of the Laurentian or Fundamental Complex do not represent the earth's *erstarrungskruste* but are merely portions of the earth's crust, of sedimentary or other origin, which have been buried deeply enough for hydrothermal fusion and have afterward been disinterred by long continued denuding forces. Good examples of wide areas of granitoid rocks, merging at many points into gneiss and having an eruptive contact with the overlying rocks, are to be found, according to Dr. Dawson, in the Coast ranges and Interior plateau of British Columbia,[33] but here the Basal Co of Jurassic age.

Concluding Observations.

It will be observed that the term tian has been employed in this paper son and other Canadian g are accustomed to employ petrographical and structu for crystalline gneissic or rocks underlying the Huronian. Th rocks have consolidated at a later ti the Huronian is evident, and theref have not the position in time whic supposed when the name was given. be advisable to provide another des for these widespread rocks, which oc same position structurally and are f practically the same materials as to t whose attitude with reference to the ian corresponds to Logan's original H

Position of the Couchiching series in geological time

How much of the 2,000,000 squar the Canadian Archean presents the lationships as have been described paper, and how much shows the unconformity between Huronian and tian can be determined only by car work. If the eruptive contact is th type and the Huronian which rest antly on the Laurentian turns o really later in age than Lawson's we must look on the Couchiching presenting the oldest known rock would carry back the ordinary sed deposit of sands and clays to the l of known geological time.

[33] Geol. Survey of Canada, 1886, pa 1894, part B.

logy of Base and Meridian Lines in Rainy River District

By William Arthur Parks B A

Introduction

ER instructions received from the irector of the Bureau of Mines I left ›ronto on May 15, 1897, and joined n at Ignace on the 17th. By canoe ough a chain of small lakes to the were enabled to reach our in itial e intersection of the third base line fourth meridian on May 21. This was continued northward from this til June 12, a distance of about 32 From five miles south of the railway iles on the new line the country rock and is succeeded by a narrow strip and mica schist which passes into of gneissoid granite extending to 28th mile, where it enters Huronian

ıe 14 we left this line and by way of ish river and the chain of lakes to reached Sturgeon lake and began the to the westward from the 120th on the Thunder Bay boundary line 21. This line traverses Huronian about six miles, when it enters a ın area which continues to the inter- of the fourth meridian, where it nother Huronian belt which it fol- he 64th mile post.

y 29 the camp was moved to Dinor- rork was begun on the fifth meridian 31. I remained in Dinorwic to ex- e Ruby mine and rejoined the party it 2.

ith meridian traverses a Huronian about six miles, then five miles of beyond which it re-enters the Huro- l continues in it to a point about between the base line and the boun- he Lac Seul Indian Reserve.

By way of Pelican lake and the Wabigoon river the party arrived at Dryden on September 18, and I was able to report in Toronto on Monday, September 20.

In all about 166 miles of lines were run, and throughout this distance I succeeded in examining the country for about two mile on each side of the line. The results of these investigations are herewith given.

Many small and nameless lakes occur along the surveyed lines, and for the purpose of identification these are indicated by numbers on the accompanying map.

I desire to express to Mr. Niven and Mr. Neelands my thanks for assistance afforded me during the summer, and to Professor Coleman for numerous kindnesses during the preparation of this report, more particularly the determination of many of the rocks described.

General Geology

Preliminary work from Ignace.

The country in the immediate vicinity of Ignace is well covered by a mantle of glacial deposits, but about half a mile north of the town the land reaches a somewhat higher level and outcrops of granite of a coarse nature are numerous. Beyond this elevation the land rapidly falls to the level of lake 2, the entire shores of which are composed of the same rock, which however presents in places a slightly gneissoid aspect with a nearly vertical dip; this is particularly evident to the south of the railway westward one-half mile from the town. According to Mr. Cobb of Ignace this granite area is succeeded by slate (?) about five miles to the south, near the contact of which he has located some deposits of auriferous quartz. The stream flowing from lake

2 takes a northeasterly direction with a considerable fall in its first stretches and an extremely tortuous river bed beyond. To the westward the granite crops out at an elevation of 100 feet above the portage and a high ridge with N. and S. direction occurs about half a mile to the east, continuing northward to the shores of lake 3. On the west side of this lake the exposures are numerous and high, with inclusions of binary granite and large masses of felspar; in places this granite shows some schistosity, dipping 20° southwardly and striking N. 80° E. A short creek connects lake 3 with lake 4, the bed of which is choked with boulders, rendering it difficult to find any rock in situ. On the northern side of this lake and a little to the west is a high hill presenting beautiful exposures of granite, porphyritic in places with crystals of quartz four and five inches in diameter. Eastward one mile from the line the country is much rougher, with precipitous cliffs traversed by veins of binary granite.

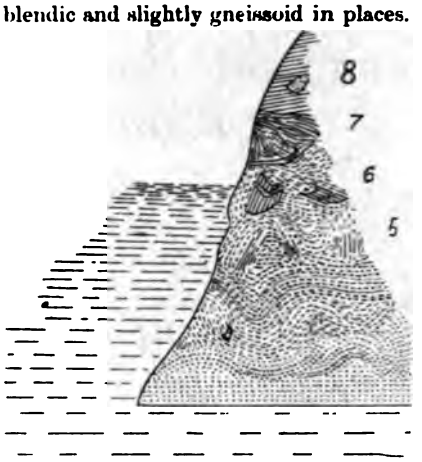
Fourth Meridian Line.

Mr. Niven's survey began at a point nine miles north of Ignace and three-quarters of a mile east of Indian lake, at the intersection of the fourth meridian line and the third base line, and the fourth meridian was carried due north a distance of 30 miles to a sheet of water named Thirty-Mile lake. My work on this line began on Indian lake, which I explored to its outlet into Bear lake, making frequent cross-sections of the country eastward to the meridian line.

Exploration of the Fourth Meridian Line.

The passage into Indian lake from lake 4 is broad, with little or no current, and its banks present glacial accumulations for the most part. Immediately on entering Indian lake high precipitous cliffs of granite occur, and this rock continues to the point at the northeast corner of the lake, while the line traverses similar territory to the shores of Victoria lake, so named from having been discovered on the 24th of May. Throughout this area the most noticeable feature is the occurrence of ridges running N. E. and S. W., forming the axes of most of the points stretching into Indian lake and determining the direction o small streams. These ridges also are n able from the fact that they become blendic and slightly gneissoid in places.

Indian and Victoria lakes.



Contact of gneiss and granite on Indian lake.

At the previously mentioned point i N. E. angle of Indian lake the granite p into gneiss by a fairly c marked series in which the f ing eight zones were distingui the numbers corresponding to the figu the accompanying diagram.

Granite merges into gneiss.

(1) At water's edge, ordinary gray g with some thin seams of quartz st N. 30° W.

(2) Slightly contorted granite passin perceptibly into the above, only ap where weathered.

(3) Distinctly laminated as to the with large segregations of pure white not seen anywhere in the granite area.

(4) Still granitic, but showing a tende cleave by horizontal planes into strata two feet thick, with strong lamination partings.

(5) Containing fragments of distinct gneiss, shading imperceptibly into the gr mass.

(6) Containing fragments of gneis shading into the ground-mass; gneiss cr and filled with strings of granite, als gneiss drawn out in bands into the gra

(7) Extremely gneissoid and much torted, the laminae running in all dire and being filled in with granite.

(8) Gneiss with inclusions of granite.

rth and east of this point numerous ures of gneiss were found throughout ourse of the river into Bear lake. This connecting river is about a chain wide at the narrowest point, where ver it is flowing with great velocity and two magnificent cascades with a total about 25 feet, necessitating two portof 10 chains each. The line passes into rea of gneiss immediately to the north ctoria lake; where however the above bed succession of rocks is not observbut a series is presented of which the ring are the more noteworthy in the and a half of line between Victoria and lakes.

Fine grained mica schist; strike N. .; dip 10° S. 20° W.

Coarse pink gneiss, laminated W.S.W.

Summit of ridge, mica schist and interations of coarse contorted pink gneiss.

Large area of gneiss laminated W. S. W. illed with masses of granite, around the gneiss presents a marked flow ure.

Lesser summit at 5th mile post.

Hollow with some exposures of magit graphic granite.

Light and dark gray mica schist interated.

Depression, fine gray gneiss.

th of Bear lake are some exposures of gneiss, but both to the east and to the west of the line areas of undoubted granite occur passing by imperceptible degrees into the gneiss for ost part, but occasionally presenting a contact. Some considerable elevations in this region with precipitous walls of et, notably to the east of lake 8. North s lake is a minor height of land separatear lake waters from those of Elephant

Near the 10th mile post a prominent of pink and gray gneiss crosses the line nd S. W. Two miles west of this point dge reaches a much higher level, overg lake 10, and affording a view of a long h of low lying country to the westward. 9 is rock-bound nearly all around, some ic rock appearing but gray gneiss preating. After passing the 14½ mile the rock is much less gneissoid, while the granitic appearance is more pronounced. However throughout the whole region from Bear lake to the diorite belt south of English river the granite and gneiss are in places extremely hard to distinguish. In the map these Laurentian gneisses and granites are colored alike, but a rough line of separation might be drawn N. E. and S. W. crossing the line at 14½ miles and constituting by no means a sharp division, as almost imperceptible gradations are apparent at many points on both sides of the line. For a large part of both areas the term "gneissoid granite" would be most appropriate.

Lake 11 presents high rocky shores of granite cleaving N. E. and S. W., strewn with boulders of gneiss, granite and quartzite and disposed in a series of parallel ridges N. E. and S. W. on the flanks of which occur some streaks of mica schist. The granite in this region crops out in numerous small hillocks and rises in a few places to a considerable height the greatest elevation occurring two miles east of the 14th mile post, whence a long vista of low-lying country is visible to the north, east and west. The line enters lake 12 over an extremely rough granite slope and the same rock is well developed all around the lake, as also on lake 13 which is practically a bay of Flying Loon lake—at least it is so considered on some maps, although separated by a considerable stretch of river. On the west of lake 13 the rock is rather gneissoid and of considerable elevation, with mica schist and streaks of quartz. The waters of Elephant lake enter this lake through a channel which does not seem to be cut in the solid rock, but which is lined with boulders over which the water rushes with great violence; a well used portage of a few chains in length connects the two. The shores of Elephant lake are granitic, as far as my limited opportunity of observation extended.

In a granite belt to Flying Loon lake.

North of Flying Loon lake the country is comparatively level, with many large muskegs and only occasional rock exposures. At about the 22nd mile post the line enters a belt of diorite which bends off to the southwest from that point, an actual contact being found 50 chains west of 21½ miles. Following this belt eastward

Diorite north of Flying Loon lake.

it is found to become finer in grain and finally to pass into diorite schist, and appear, as such on the shores of Flying Loon lake. One-half mile before impinging on the lake it presents a high cliff facing the lake in which occur many segregations of quartz.

The line passes out of the diorite at about 18 chains in the 24th mile, and although the contact is covered in a swamp on the line, it can be found both to the east and west and presents much contortion and small faulting.

Gneissoid granite and fine grained diorite.

From this point northward and beyond English river the gneissoid granite is again prominent, covered with swamps and traversed by winding streams flowing for the most part westward. The next change is at 24 miles 50 chains, 1½ miles west of which point a hill rises to the height of 150 feet, the bottom of which is gneissoid granite but the summit is composed of an extremely fine grained diorite which is separated from the granite by a band of pink quartzite, owing its color to numerous small garnets. From this point the contact turns off to the northwest. This belt crosses the line at 25 miles 20 chains and exhibits in many places an east and west schistosity and constitutes a narrow belt 15 or 20 chains wide followed by the characteristic gneiss, which is succeeded by a narrow fringe of hornblende granite on the south shore of lake 14. This shows a sharp contact with the gneiss to the southwest, while a deposit of coarse diorite with pink felspar and pyrites occurs at the southwest end of the lake and disappears in that direction in a morass. North of this lake the hornblende granite continues for about 10 chains, when it passes into gneiss running N. E. and S. W., the country in the vicinity being well covered with drift accumulations and filled with small ponds. A ridge of fine grained diorite crosses the line N. E. and S. W. at 26 miles 50 chains, and a quarter mile to the westward becomes schistose N. 50° E. and dipping 40° S. E. For two miles to the west no exposure could be found, so well is the district covered with soil and boulders of diorite and gneiss. This dioritic belt rises into a ridge at the 27th mile post and falls into a large swamp by a steep declivity.

North of English river to end of the line.

Beyond this swamp appear the Huronian strata represented by a rock of a hard, compact nature, a sort of altered porphyrite presenting a schistosity N. 55° W. and a jointage S. 45° W. dipping 25° S. E. The laminated structure is well pronounced, but is variable in direction and shows considerable contortion and flow structure in places. This rock crops out at many points on both sides of the line, but the area in general is of a swampy nature; a large cedar swamp crossing the line at 70 chains in the 28th mile and extending for some miles to the eastward, being bounded to the north by a ridge of the above rock crossing the line at 20 chains in the 29th mile. The long, tortuous river shown in the map crosses just west of this elevation, is fairly navigable and seems to be an Indian canoe route. It was followed down by a party of men and found to enter the English river. Judging by the volume of water it is the outlet of some important lakes, possibly of Long lake, as shown on the map.

The above mentioned ridge shows to the westward more of the nature of a glacial deposit, and recrosses the line at 37 chains in the 29th mile with the river just beyond. North of the river is another parallel ridge of boulders of somewhat less elevation, showing no rock in situ.

A fine grained dioritic or hornblendic schist is found in situ to the east of the 29th mile post, but its limits are impossible to ascertain, as the country is well covered and gently rolling to 37 chains in the 30th mile, where a sharp rise occurs of about 75 feet, apparently all drift; but at one point a dark schistose rock striking N. 75° W. was found in position.

To the northward the soil is thin and exposures are more frequent, consisting of the above mentioned dark compact schist with seams of quartz following the jointage divisions rather than the planes of stratification, thus testifying to their later origin.

For some distance east and west of the line the formation rises into rounded hills with good exposures, the rock becoming more schistose and greener in color. One-half mile west of 30 miles 30 chains is the southern end of lake 15, whence a creek flows out to the southeast. The eastern shore is

low and swampy, while the western is higher and shows the characteristic schist, the last exposure of which south of Long lake was observed at 31½ miles. As the country north of this point is strewn with boulders of gneiss, a sharp outlook was kept for an outcrop of that rock, which was finally found on a ridge at 31½ miles with laminae N. E. and S. W. This was followed to the shore of lake 16, but no actual contact was found owing to the swampy nature of the country. No further exposures were met with south of Long lake. But as east of the line Huronian rocks occur on the shore, it is extremely doubtful where the exact contact lies. According to Professor Coleman in the Report of the Bureau for 1895, Huronian rocks constitute the entire eastern shore of lake Minnietakie. Therefore it is evident that the tongue of Laurentian rocks which, with the exception of a portion of the southeast shore, surround Long lake must come to an end somewhere to the southwest; the probable line of contact is indicated on the map.

Canoe route to Sturgeon Lake.

Ascent by way of English river.

In ascending English river from the point crossed by the line three portages of about 10 chains each are necessary to gain access to Flying Loon lake. This river is of considerable size, being four and five chains in width and broken by a large number of falls, which owing to the large volume of water are of considerable beauty and offer some danger to canoe navigation, although many of them can be run by experienced canoemen.

The northern shores of Flying Loon lake are gneissoid, while the large diorite belt before mentioned inpinges on the west side. At the portage into Otter lake Huronian schists again occur in the form of hard siliceous schists of a dark color, with strings of quartz interlaminated with similar rock filled with large epidotized crystals of felspar, the whole presenting a strong east and west lamination with felsite and hornblende and mica schists with iron pyrites This rock continues along the shore of the river and some distance south on Otter lake, the gneiss however cropping out about where the canoe route turns eastward towards Hut lake, the northern shore of which presents exposures of the schists, as also the portage into Pine lake. Through Pine lake, White Rock lake (so called from a large isolated mass of quartz said to contain copper pyrites) and Young's lake, owing to the necessity for direct travel, I was unable to make any detailed examination, but am of opinion that the schists constitute the prominent rock of the region. Towards Young's lake the portages are all short and the whole chain constitutes an ideal canoe route, which terminates by a half mile portage into Sturgeon lake. This ridge though not presenting any considerable elevation represents the height of land separating the drainage area of Sturgeon lake from that of lake Minnietakie; both of which however find a common level in Abram's lake, the former by the Sturgeon river to the north and the latter by Abram's falls to the south.

Around Sturgeon lake.

Sturgeon lake is a magnificent sheet of water, with a length of probably 30 miles, the sunrise over which on June 18, with its setting of dark green shores and artistic touches of rosy clouds, constituted an impressive scene of vastness, beauty and solitude. On the west shore of Sturgeon lake and on the adjacent islands green schists occur, but seem to be interlaminated with an extremely altered light green diorite or diabase, which latter rock becomes more pronounced behind the old Hudson's Bay Post where some prospecting has been done, an account of which will be found in the economic portion of this report. These schists, as observed on a small island where we were forced to take shelter for a day owing to the high winds from the northeast, are found to strike N. 50° E. and to joint N. 8° W. with a dip of 10° N. W., and to become sericitic where the boundary line between Rainy River and Thunder Bay strikes the north shore..

Northward on the Rainy River and Thunder Bay boundary.

The boundary line between the Rainy River and Thunder Bay districts was run seven years ago by Mr. Niven. It was found to be quite open and no difficulty was experienced in following it except for the last few miles, where a forest fire has made it less distinct. The schists continue on this line, but are broken by a boss of eruptive granite ris-

ing into a hill of about 75 feet and forming the west and south shores of lake 18. From this granite area to the intersection of the base line extend a series of schistose rocks consisting of diorite schists, hornblende schists and felsite schists of various colors interlaminated with altered diorite or diabase and porphyrites, the whole forming a series of troughs striking east and west, with a dip about 20° southward and tending to cleave into rhomboidal blocks with numerous small seams of quartz.

Fourth Base Line.

The survey of the fourth base line was commenced about seven miles north of Sturgeon lake, at the 120th mile post of the boundary line between the districts of Thunder Bay and Rainy River. This latter line was run by Mr. Niven in 1890, starting on Sewell's base line (west from the northwest angle of the township of Strange) at a point about two miles north of Hunter's island. The fourth base line was surveyed due west from the boundary line a distance of 90 miles to the intersection of Niven's sixth meridian.

The small lake (No 20) near the starting point of the fourth base line on the Thunder Bay and Rainy River districts boundary presents exposures of the previously described schists on its shores, and they extend about a mile north of the line, becoming distinctly hornblendic and compact at that point and containing a band of quartzite about four feet thick, bounded on each side by eight inches of crystalline quartz. In about a quarter of a mile gray Laurentian gneiss follows with N. and S. ridges and E. and W. lamination, forming the major part of the shores of lake 21 with schists on the southern bay only.

Westward on Niven's Fourth Base Line.

On the line between one mile 50 chains and one mile 53 chains a ridge crosses, running S. 58° W. on the east and S. 20° W. on the west, containing crushed granite and a dike of pyritous diorite rising to considerable elevations southward, with exposures of diorite and hornblende schist. At two miles 56 chains a thin belt of diorite crosses the line, becoming very schistose eastwardly and passing imperceptibly into the country rock, while to the north its contact bends west and passes about 10 chains north of the line in a northwest direction and is followed by a hard, fine grained schist with inclusions of coarse diorite, while the Laurentian contact approaches to within 30 chains of the line.

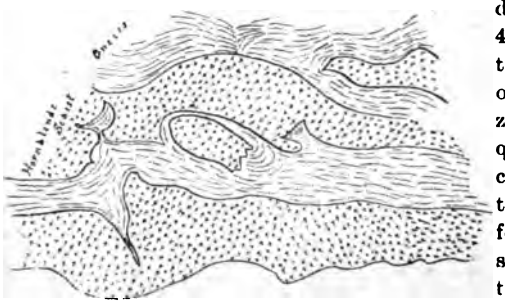
North of four miles 28 chains the rock is most fantastically contorted, the fine and coarse diorite being twisted in all directions with the clastic schists, continuing north to the contact just south of lake 22. A diorite belt reaches a considerable elevation on the line at six miles 15 chains, presenting a lamination N. 50° W., and just beyond the Laurentian contact sweeps southward, crosses the line and bends to the east, constituting with a hornblendic aspect in places a large part of the shores of lakes 24, 25 and 26.

Lake 23 is enclosed in the schists, which are dioritic in places, and the stream westward is about one-half chain wide and navigable only in short stretches; near its outlet into lake 24 it falls a few feet over broken boulders of Huronian origin. This lake is doubtless in connection with lake 25, which flows out to the westward by a short creek traversing a bed of boulders, mostly gneiss, overlying hornblende gneiss in situ: while this rock crops out to the south of the passage and appears to reach a greater elevation in that direction. Lake 26 is rock-bound, while lake 27 is an old beaver pond, with evidences of the work of these industrious animals forming a belt two or three chains wide around the entire lake, the water of which flows west, though its destination was not determined. This whole region is an intensely metamorphosed tract in which numerous dioritic bands representing periods of injection play an important part. Gneiss continues to lake 28, on the west side of which it is underlaid by a coarse pink quartz-diorite. This rises from the gneiss to an elevation of 15 feet south of lake 29 and continues to 10 miles 2 chains where the gneiss again comes in. Lake 29 flows into lake 28, which has an outlet to the southwest into Lake of Bays, the channel at the outlet being steep and rock-bound with both gneiss and the above mentioned quartz-diorite in evidence.

Schists, diorite bands and gneisses.

Gneiss forms the shore of the large lake called by Mr. Niven the Lake of Bays, being a short translation of an exceedingly long Indian name signifying, "The lake which one may enter at any point and find a bay directly opposite." Mr. Williams of Lac Seul informed me that this lake forms a part of a canoe-route connecting Sturgeon river with Sturgeon lake. Just before reaching the lake the rock interlaminated with hornblende schist reaches a considerable height, affording a view of 10 miles to the north and west.

Lake of Bays to Thirty-Mile lake.



Contact of Laurentian gneiss and hornblende schist.

In the accompanying sketch is shown the contact between the gneiss and hornblende schist north of the line. This latter rock occurs in considerable masses, and as the gneiss for the most part contains fragments of it and shows flow structure conforming to the lines of contact it must be of later age.

West of the Lake of Bays the rock is more generally covered and exposures are few; on lake 32 however some outcrops of gneissoid granite occur, and to the west of Dominion lake is even more granitic, cropping out in rounded hummocks at various points both north and south of the line, and on the line at 20 miles 60 chains, 21 miles 10 chains, 22 miles 30 chains.

A very large muskeg with flat clay floor stretches from 21 miles 40 chains to 22 miles 60 chains, and extends for six or seven miles northeast and southwest with occasional islands of granite. The country rises and the granite comes out strong just west of this depression, and presents a more schistose structure, N. 60° W., on the shores of lake 35; but between lakes 35 and 37 it is distinctly fine grained and granitic, while beyond it is more gneissoid and rises into ridges tending northeast, reaching its greatest elevation near the shore of Long lake where it attains a height of 150 feet, affording a magnificent view of Long lake and the country for 20 miles to the north. The gneiss extends around the northern end of the lake where it assumes a somewhat different aspect, being fine grained, red and most distinctly schistose. The contact with the schists of Huronian age is again found about one mile north of the point where the line cuts the western shore of this lake, and the immediate contact is a fine grained black schist passing into diorite a little beyond; strike N. 40° E., dip 40° N. 50° W. This line of contact crosses the line at 27 miles 40 chains and comes out on Thirty-Mile lake in a series of fine quartzites and hydromica schists, with veinlets of quartz and a narrow belt of diorite all much contorted and broken. On the west side of the lake the rocks noted are fine laminated felsites with a little mica, and in some places still finer with blebs of quartz. The country to the southwest of this lake is more covered and the exact contact with the gneiss not determinable. The previously described belt of schists on the fourth meridian forms the southeast shore of Long lake and passes into the gneiss on the last of the chain of small islands shown on the map, where, as on the shore opposite, the contact is marked by alternate belts of hornblende schist and white and red felsite and quartzites, showing much contortion and shearing.

West of Thirty-Mile lake a belt of diorite occurs at 31 miles 40 chains and is interlaminated with an extremely altered porphyrite passing into agglomerates. These rocks present on the weathered surface the appearance of a fine grained matrix, with whitish inclusions and veinlets of quartz. With numerous bands of diorite this rock contiues and forms the shores of lake 39, on the west side of which it is extremely agglomerate-like, while to the northeast it reaches a higher level. The shores of lakes 40, 41 and 42 present much the same character. South of the line, just west of lake 42, the rock shows no trace of dioritic belts, but rises into hills of 100 feet showing a stretch of burnt country to the west, south and southeast.

Agglomerates, diorite and sericite schists.

West of lake 41 the country is low and a large swamp stretches to the southwest; while to the north and east across the narrow stream from lake 42, through a most difficult country to traverse, are found some high hills presenting a view of 10 or 15 miles of burnt country with green ridges beyond to the northward. Near the line on the shores of lake 43 are some fine examples of sericite schists with cubes of pyrite passing into the harder schists and interlaminated with them, S. 35 E. This lake flows out at the south through a large marsh, while its shores rise on the west side into a ridge of agglomerates interlaminated with some sericite and followed immediately beyond by a deep valley. Various stringers and interlaminations of quartz are found in this neighborhood. On the north side the rocks assume the character of coarse clastic schists with a little sericite, the latter apparently in strings etc. in the other rock.

The south and southeast sides of lake 44 are low and swampy, but northward on both sides they rise to greater heights, notably on the west side where a hill of diorite of 150 feet forms an imposing centre, on approaching which around the north end of the lake a coarse agglomerate with striated inclusions is met with. From the summit of this hill the country is found to be burnt to the north, northeast and southeast as far as the eye can see, but is green to the west and southwest. The burnt belt seems to be about ten miles wide, stretching north 10 west and south 10 east. The high bare hills shown on the map bear N 10 E. from this point. This large hill of diorite is flanked on the west by ridges of the same rock of somewhat less altitude, followed by dark green hornblendic schists. Lake 45 is an extremely picturesque sheet of water flowing into lake Minimetakie in reaching which from the line bands of pronounced agglomerate with belts of diorite are met with, while on the shores a fine chloritic schist with crystals of calcite and a green hornblende schist are common.

Second Abram's lake.

One and a half miles north of 39½ miles the Laurentian was again encountered, presenting a granitic aspect at first but becoming more gneissoid beyond. This observation holds true for the whole of this line of contact to where it crosses the line some miles west of Big Vermilion lake.

On Abram's lake south of the line to the falls the rocks are for the most part dark hornblendic schists and green schists with veinlets of quartz. From the line to the outlet of Sturgeon river slates (?) and soft sericite schists occur striking N.E. with vertical dip, showing bands of much altered diorite and some pyritous shales. On the west side of this arm the rocks are as a rule harder and highly silicious schists, with some hydromica schists on the bay next the passage into Pelican lake. Southward from Abram's falls (the passage from Minnietakie into Abram's lake) are fine green schists succeeded by a narrow strip of diorite and hard dark schists with a few veinlets of quartz. The southwest point of the lake and the west shore is composed largely of dark schists passing into agglomerate, with bombs of six and eight inches of quartz diorite and other rocks. A narrow belt of the soft sericitic variety occurs at some points apparently associated with a fine white schistose quartzite. The above mentioned agglomerate crops out on the small island crossed by the line and on the other adjacent to it.

The south bay of Pelican lake is largely of dark fine grained green schists. In the second bay of this lake the rocks are fine green micaceous and quartzose schists with pyrite, rising into a bluff of considerable height known as the Sioux Lookout, notable as being the site of the last battle between the native tribes and their powerful enemy from the south. The shores northward from this point are practically of the same nature until they reach the Laurentian contact near the outlet of Vermilion river, at which point fine granitic and felsitic bands occur, all much contorted but becoming distinctly gneissoid at the head of the bay. The waters of the Vermilion lakes enter Pelican lake by the Vermilion river, navigable throughout but for two portages of about a chain each; the first occurring where the water first leaves Vermilion lake in a beautiful fall of about 20 feet over a vertical cliff, and the second about half way down

Pelican and Vermilion lakes.

where a short rapid breaks the stream, easily passed however by canoes at the season of high water. The water of this river is beautifully clear, the faintest ripple mark being easily seen in the sand at a depth of six feet, and at its outlet into Pelican lake it presents a marked contrast to the much dirtier water of the latter.

The north shore of Pelican lake was found to be composed entirely of gneiss, and the same rock forms the entire boundary of Lost lake, presenting bands of granitic and felsitic matter in places, and inclusions of rose quartz and belts of dark mica schist.

The rocks on Vermilion river are extremely fine grained dioritic schists, and dark gray highly silicious schists, with numerous veins of quartz.

On Vermilion lake to the north occur diorite belts, with quartz at the contact with the country rock. Being engaged in examining the shores of Pelican and Abram's lakes I did not follow the line between Pelican and Vermilion lakes, but through the kindness of Mr. E. Neelands I obtained specimens of rock from various points along the line and found them to be in no way different from those previously described.

The two lakes 48 and 49 near the intersection of the fifth meridian are entirely surrounded by rocks of a similar nature, while at the point of intersection occurs the southern limit of a considerable belt of diorite stretching N.E. and S.W. and rising to a hill of 100 feet north of lake 49, where it is capped by a fine hard schist with schistose diorite on the flanks. This elevation seems to represent an eruption of diorite which has carried up with it a portion of the rock through which it found its way. West of this hill there occurs an area of mixed green and white rock, apparently crushed quartzite with or without a chloritic or hornblendic coloring ingredient, crumpled with belts of diorite and crushed granite.

Vermilion lake to the Sixth Meridian.

At about 61½ miles are 30 or 40 feet of a quartzose schist with much magnetite, causing a local variation of the magnetic needle of 33° E. This is followed to the south by diorite and more rock of the same nature.

Fifth and Sixth Meridians.

To the north of lake 50 the nearness of the Laurentian rock is shown by hard laminated quartzose rocks with mica schist and granite, while on the west of the same lake a hill of diorite marks the last of the Huronian rocks, which is followed by some felsites and finally the Laurentian gneiss. This continues with no break to the intersection of the sixth meridian and down the same past Pelican lake. At the third portage out of this lake on the Pelican river a mass of mica schist was observed, but the actual contact with the Huronian of Pryden and vicinity was not found, as the passage down was made in haste and for the most part at night. Some remarks on the surface conditions of this Laurentian area will be found in the part of this report devoted to Surface Geology.

Sixth Meridian Lines.

In the vicinity of Taché and Bois Brulé on the C. P. R. the Huronian rocks are again found, as also on the east shore of lake 75, where they consist of hornblende schist, diorite and felsite schists of a hard compact nature, with partings of crushed granite or felsite followed by an outcrop of porphyritic granite of narrow width. North of this boss the rock is laminated (N. 20° W.), while another mass of granite is found on the north shore of the lake with a contact N. 70° W. but does not continue far, being followed by dark schists forming the lower portion of a hill of 100 feet or more, the top of which is composed of a coarser and more dioritic rock. West of this hill the country is extremely rough and broken, and granite crops out again at the distance of about one-half mile, with the schists much puckered at the contact. Farther west are a number of granite belts running north and south, i.e., cutting the schists almost at right angles, the latter rock appearing at the north-east angle of lake 76.

Features of the Fifth Meridian.

Continuing north on the line, the country is still very rough and the rock where exposed presents examples of dioritic schists and hard quartzose schists wheathering white, having a strike of N. W. and dip of 15° S. W. The line of contact with the eastern mass of granite shown on the map is characterized by the occurrence of quartz and mica schist with

(3) the Wabigoon area. The rocks composing these areas are essentially similar, no sing'e representative being found in one which is not met with in the others. In the petrographical part of the report will be found descriptions of the more important of these rocks. The Laurentian areas show granite near the contact in almost all cases, sometimes extending for miles with no trace of lamination, e g. between Dominion lake and lake 35 ; at other points presenting a slight lamination in the mica only ; while the true gneiss structure is apparent at numerous points, notably around Lost lake.

Surface Geology

The Canadian Pacific Railway at Ignace crosses a narrow strip of land between the small lake to the south and the one to the north. This strip seems to be essentially a moraine composed of unstratified clay and sand filled with boulders of granite and gneiss, with occasional blocks of diorite and Huronian schists. Gneiss boulders 10 feet by six feet

Morainic deposit at Ignace, on the Fourth Meridian Line.

park-like area of scattered pine a mile wide is crossed, and shortly after passing to lower ground an entirely open meadow some 10 acres in extent is reached, rich in grass, quite level, and of seemingly dry or sandy soil. The country here becomes more broken and hardly as suitable on that account for agriculture, although the soil is very promising, and soon the burnt country is reached, a fire which passed through here some time ago having cut a swath 10 to 15 miles wide, leaving the rocky ridges almost bare, an ideal ground for the prospector. Owing to the thickly timbered nature of the ground in the previous eight miles, little rock was visible, only one outcropping, a mass of schist with bands of blue and white quartz. This outcrop was thickly impregnated with mica, pieces one and two inches wide being detached with a knife. Several veins of quartz were noted, carrying iron and copper pyrites; others of greenish hue and tinged with chlorite. About half a mile from the road, close to the western shore of Sandy lake, a vein 30 feet wide composed of alternate layers of quartz and micaceous schist has been located, with a smaller vein running parallel. This vein has been traced for nearly two miles, and crops up in various places over a length of six miles. Near Rocky rapids stringers of rose-colored decomposed sugar quartz were noted, and about a mile away a large dike of quartzite of a bluish black nature, heavily mineralized with iron pyrites and stained with hematite, afford of gold and silver. Owing to the burnt-o of the country the ridges of rock are alm of vegetation, and run for miles at varying above the general level, offering a great prospectors, whilst thousands of cords well seasoned dry wood are lying on the and could be profitably gathered. The belt can be said to extend from within 10 Wabigoon to the shore of lake Minnetakie near the latter the rocks are gradually over as the vegetation gets more abundant

" Several lakes run close to the road, no mention is made on any maps ; Jackf about three miles long by one wide, Tro two miles long with deep bays, and thr unnamed lakes, one rather large running to Minnetakie and about a mile distan T. B. Speight has surveyed claims near t lake during the winter, so that it will be located.

" With the exception of a fringe of w red pine on Sandy river no marketable tir been sighted, though an immense area pine must have stood close to Minnets Sandy lakes many years ago. The rottin of pine trees two to three and a half feet d destroyed by fire, are scattered throug country, and one isolated pine of huge s still growing, being passed on the road."

with large inclusions can be seen portage between the two lakes. morainic deposit a large kettle h observed to the east of lake 2, wit about 20 feet high on the outside and within. This character of country ol the shore of lake 4, north of which is an area of fine white clay prol post-glacial age. This passes northw a stretch of fairly well covered la boulders and only occasional exposure shore of Victoria lake. This area, the characteristic soil is clay, stretch the shore of Indian lake eastward fo siderable distance beyond the line.

On the northern slope of the he land between Victoria and Bear lakes of coarse white sand apparently derive the decay of gneiss in situ.

North of Bear lake a somewhat sca soil extends to about 10½ miles, w passes into an area comp sand. With many inter this continues, scantily de around lake 11 and well shown on the

A region of sand and sandy-clay.

to about the point where the line
13. The region traversed by the
e vicinity of Flying Loon and
ıkes is a fairly heavy sandy clay,
inishing percentage of sand to the
tly level and with few exposures.
ugh this accumulation that the
Elephant lake make their way,
without encountering the country
ittle to the east of the line on the
ying Loon lake the drift accumula-
banks of some height, containing
stose and eruptive masses than
rved farther south. An erratic
here resembling a pink sandstone,
examination with the microscope
he fact that it was composed of
ıartz grains, cemented by a silicious
lored by ferunginous matter and
in places small calcite crystals.
ock in any way resembling it sub-
found in situ occurs on the south
ig Vermilion lake, but as the drift in
t has undoubtedly travelled s.w. it
y have had its origin in that locality.
of Flying Loon lake the soil is
ly, fairly level and studded with
ıps two or three miles in diameter.
21 miles 40 chains the country
greater altitude and exposures are
ıent, while the drift is filled with
boulders of gneiss and granite
n to have been derived from the
eath them and not to have been
by glacial action. It is quite
ıat a large area of the thin soil in
ict has been formed by subaerial
dacial striæ are to be seen on the
f the hills of hard dioritic-schists to
of 22 miles 60 chains, having a
s. 20° w. This ridge falls into a
np and the country continues com-
low to English river, immedi-
:he north of which, after a slight
sandy soil and numerous swamps
:teristic, but a hard clay soil is met
he 25th mile post. Beyond here
its of the hills are composed of fine
d, while stiff clay seems to occupy
ws. The superficial mantle is of
ble thickness and rock outcrops are
dingly scarce.

North of lake 14 the drift is very tumultuous, with scanty soil, enormous boulders of all kinds and numerous small ponds and swamps. East and north from the 28th post the country is flat and filled with large cedar and scrub spruce swamps, to about 28½ miles, where two parallel ridges of drift accumulations cross the line N.E. and S.W., affording a channel between them for the river at that point. This stream is of some size and probably constitutes the outlet of Long lake; it is navigable, but numerous portages are necessary. From this river to Long lake the country is gently rolling, with a sandy soil for the greater part. Exposures are few, except in the vicinity of 30 miles 40 chains

The portages along the route from English river to Sturgeon lake were found to be for the most part over clay, the one between Otter and Hut lakes showing glacial striæ S. 12° W. All the lakes of the chain are extremely pretty and generally the shores have a green aspect, but the timber is of comparatively recent date. Two grand old pines overlook the portage above mentioned, and probably represent the sole survivors of a once luxuriant pine forest. Around Sturgeon lake and on the islands banks of sand occur 20 or 30 feet in height. A panning of this sand resulted in garnets and magnetite, but no gold or sulphides.

English river to Sturgeon lake.

On the Fourth Base Line.

Westward on the fourth base line from the Thunder Bay boundary line the soil is very thin and for the most part is coarse sand, while large boulders are not frequent until we reach lake 24, where the stream from lake 23 flows over a bed of boulders of Laurentian and Huronian rocks. The waters of this chain of lakes find their way into Lake of Bays, and are fed by numerous swamps lying to the northward. The soil continues scanty to Lake of Bays, beyond which however it is deeper and chiefly sand, while around lake 32 there is a greater development of clay than hitherto observed on this line.

From Boundary Line to Long lake.

The west shore of Dominion lake shows a curious feature, namely a bank of sand six feet high following the contour of the lake on this side. Beyond this ridge lies a swamp,

to avoid which animals of all kinds have used the bank as a runway, making a distinct road around the lake. This formation is evidently due to the sand washed up by storms from the east being cemented and retained in position by the cedars, which form a fringe around the lake.

From the northwest corner of this lake a boulder ridge, perhaps a moraine, stretches s. 10° w. and crosses the line a little beyond the lake shore. A large swamp with spruce bush forms a belt about a mile wide and six or seven miles long, stretching N. E. and S. W. It contains a few ponds, which though small appear to be of considerable depth. At its southwest corner it seems to be drained by a stream which I followed for a mile without being able to reach its termination in a lake. Around Long lake the soil is sand and fairly thick northward towards lake 38, while around Thirty-Mile lake the rock is bare except towards the south, where it is overlaid by numerous boulders to the shore of Long lake on the fourth meridian.

Sand continues to predominate to Lake 39 and glacial strie S. 40° W. are seen at 30 miles 40 chains. The waters of lakes 39, 40 and 41 flow out at the north end of the first lake and probably make their way into

From the Fourth to the Fifth Meridian.

the Sturgeon river, as also do the waters of Thirty-Mile lake. The stream shown on the map as entering lake 41 just north of the line was followed up for some distance, but was finally lost in a swamp. Although of considerable size at its mouth, it rapidly narrows and shows very little current throughout. Lake 42 has particularly dirty water, but sandy shores for the most part. The creek to lake 41 at the time of observation, July 14, was entirely dried up, making the lake a stagnant pool, and considering its size the most unpleasant sheet of water seen during the summer. To the south of the 35th mile post is a slight elevation, and beyond a large swamp probably the same one that the above mentioned stream drains. This swamp is separated from lake 42 by a sharp ridge. Fine sand occurs over the whole of this region. Lake 43 passes out to the south by a broad but shallow stream into a muskeg. A means of reaching it may possibly be found by following this stream towards lake Minnietakie, in which di it doubtless forms connection with lakes. I consider this important, as opinion the country around this la worth prospecting. The high diorit west of lake 44 is a distinctive point i topography of the district, and the cou exceedingly rough and very difficult to t From this hill to lake 41 the country i hilly nature, rendered almost impassal large quantities of fallen timber. Thi however passes into the green bush immediate vicinity of lake 45. East o 46 the country is high, and bare of bo and timber, rising into a ridge with pines overlooking the valley of the St river. Beyond this valley are high hills of gneiss which seem to be as fa from this point as from the hill near la Sandy soil with poplar and spruce tl continues westward to Abram's lake.

Westward from the intersection fifth meridian over the numerous and porphyritic rocks is spr

From the Fifth to the Sixth Meridian.

the most part a mantle of sand, presenting in some pl level upland with small pitch pine others dropping into large muskegs. west of lake 50, as also in a minor deg the N. and N. W., are high hills, s diorite and others of felsitic and other indicating the Laurentian contact. The of this lake pass out to the south and ably find their way to Vermilion lake. 51 is also surrounded by fine sand, large area of high sandy territory str from lake 53 in a southeasterly di towards Vermilion lake, terminating a quarter of a mile from its shores. L is in possession of two families of b the house of the larger family being 2 in diameter. This lake discharges south, but not into lake 53, which also outlet in the same direction, while half to the south of it a creek of considerab flows southeast. Lakes 54, 56 and 57 found useful as a canoe route in transp our supplies, the portages between being merely "lift outs."

Some high hills intervene between 57 and 58, with still higher ones west latter lake rising to elevations of pr

above it. At the point crossed by and to the north the banks on both rticularly the west, are precipitous, a most picturesque view, shown in the accompanying photogravures. reek was followed down stream d east, and it shows numerous rapids irst mile of its course, after which it n the hollow and appears to again into a lake at some distance to the st. One mile south of lake 59 are gh hills with a valley beyond; four to s away appears a chain of hills tend- southeast direction.

hole region around lakes 59, 60, 61 s rough, but fairly well wooded in a oil, with deep moss and numerous es of the presence of moose and

Parks' lake is a pretty sheet of retching N. E. and S. W., constricted points and expanding into a bulb of ile in diameter at the southern end, it enters by a stream of a few chains Chain lake, so named from the cir- ice that the larger western arm is that width where crossed by the This lake is an extremely crooked water, consisting of five arms radiat- n a common centre E., S. E., S., S. W. W., the last being the largest and the n arm next in size. Its shores are ll around, with principally a sandy soil by numerous exposures of rock. To t of the lake the soil is clay, and this s for a mile or more north of the line o to the westward but passes into a nous sand before reaching lake 62, has low swampy shores. A large seems to sweep to the S. W. a mile f this lake and to empty into 74-Chain short distance south of the line. An dson's Bay Co. road crosses the line a istance past the 78th mile post and ies north through a similar country kes 64 and 65.

ie vicinity of lakes 67 and 68 the soil l on the ridges but clay in the flats. ream represented as entering this lake ake 69 is incorrectly laid down, as that which is of some size, bends off to the est after crossing the line. Lake 69 has rshy shores, except at two points on the east side. From this lake westward to the 84th mile post the soil is all sand spread over flats with small timber, and sinking in places into stretches of swamp. On lakes 70, 71 and 72 a scanty layer of sand occurs over an exceedingly rough country, rising into high bare hills near the intersection of the sixth meridian.

Fifth and Sixth Meridian Lines.

In the bed of the stream flowing into Pelican lake is found a clay bottom towards its outlet. This river on entering Pelican lake has formed a long neck of land on both sides of its course, thus converting both the northern corners into large marshes which were crowded with black duck at the time of our visit. The Pelican river breaks out of the southern end of Pelican lake by a fall of 15 feet, which is followed at intervals of 100 yards by two others. Below the lower fall the stream is shallow, and somewhat difficult to navigate owing to the presence of much driftwood. For two miles at least before entering the Wabigoon river large areas of light clay land are to be seen, all of which seem suitable for agriculture. The same observation holds good along the Wabigoon river. The soil on this and the Pelican river seems to be lighter and less liable to cake than that in the immediate vicinity of Dryden and the experimental farm.

On the Sixth Meridian.

Around Dinorwic, near the line of the fifth meridian, is a considerable area of stratified clay, a well of 20 feet being sunk through it by the hotel proprietor at that village without his succeeding in obtaining an adequate water supply. From the railway northward to lake 75 a fairly level and somewhat swampy tract of country is found, with soil of considerable depth, which however dies out on the east side of the lake where some rocky hills break through. This broken and extremely rough country continues to the limit of the Huronian area. The granitic rocks beyond are not broken into ridges of so abrupt a nature as those observed in the Huronian belt, but form gentle undulations, the soil being coarse, sand filling the valleys, and intermingled with many boulders of granite.

At and north of Dinorwic Station.

Between the 67th and 68th mile posts it will be observed that a number of small lakes occur; these are all located in depressions in the surface deposits, rock cropping out on their shores in a few places only. This region presents long ridges of boulders in coarse sand, the rocks being mostly granite and piled in a most tumultous manner to heights of 50 feet, and as the sand has been washed away they are now simply immense piles of stones. It may be that they represent deposits pushed before the ice sheet in one of its later and minor advances.

Ridges of granite boulders.

Clay soil is again met with to the west of the 69th post and a deposit of 12 feet or more at places occurs on the shore of lake 87. Several small streams flow north, the eastern of which is about half a chain in width and three or four feet deep in places; this stream turns to the east and crosses the line at 69 miles 30 chains. Owing to heavy rain on Sunday, August 8, the stream rose so rapidly as to flood the tents at four or five feet above the normal level. Between Big Sandy lake and the line the country is rough, with steep hills rising abruptly out of swamps. The same conditions continue to lake Minnietakie and beyond to the vicinity of Whiting's lake, north from which is an area of high level clay territory with acres of huckleberries.

Lake 91 is swampy, with no exposures and apparently extending into a long marsh to the west. To the east of Maskinonge lake, north of the portage, the rock is very rough and covered with fallen timber and raspberry bushes, making it exceedingly difficult to traverse. Maskinonge river is swampy and dirty, averaging 20 feet in width by six feet in depth. I believe it is navigable without portages throughout.

North of Minnietakie lake.

Between Maskinonge and Vermilion lakes the soil is fairly deep, with numerous streams flowing westward, sand predominating until in the immediate neighborhood of Vermilion lake where clay appears, as also on nearly all the islands. It is somewhat remarkable that even the smallest islands, mere dots on the map, in some cases not 10 feet in diameter, should retain their capping of clay, which occasionally is 10 or 12 feet thick. north shore of. Vermilion lake also clay, but a short distance inland this place to sand, which is only scantily dev to the end of the line.

Economic Geology

Throughout the granitic and gneissoi south of the English river on the meridian the only deposit possible value is the accumu of fine white clay lying to th of lake 4, but as this cont considerable percentage of carbonate o it would not prove suitable for pott for other use than agricultural pu The diorite belt south of English ri before mentioned, forms a steep blu ning north and south at a distance of mile from Flying Loon lake. On the this bluff, in the schistose diorite, ar erous small veins of quartz and qua some of six to eight inches in width. diorite belt south of lake 14 is well m ized in places, and may be regarde fahlband in which are some quartzite with garnets. One-half mile west fr miles 50 chains a six-inch vein of quar found running N. and S. in the diorite In the schistose area lying south of th and presumably of Huronian (Keewatin rocks are found very much resemblin gold bearing strata of Lake of the W Numerous mineralized belts cross this and about 30 chains west of the 30th post a vein of quartz was found two f width parallel with the transverse jo planes and not with the schistose divisi the rock; this direction of strike is co to all the veinlets of this district.

Mineral showings along the Fourth meridian.

The region in the vicinity of Hut and the portage into Otter lake pr long belts of well mineralized bands, and although no q veins were found crossing belts the district might we worthy of prospecting. On the sho Sturgeon lake, in the felsitic and di schist, numerous small seams of quartz observed. On a conspicuous point i northwest angle of the lake, about miles from the boundary line, is an old

On English river and Sturgeon lake.

son's Bay Co. post, used only at the trading season. Behind this building, near the junction of an extremely altered diorite with the gray somewhat soft schist, is a deposit of quartz in which a shot has been fired. On the north shore near the old line a softer and more sericitic rock is found which is more likely to prove gold bearing than the harder representatives of the series.

On the Fourth Base Line.

On the old boundary line between Rainy River and Thunder Bay districts the schists are plentifully splashed with quartz, but none of any size were observed. Quartz and quartzite veins, or more correctly beds, are found about a mile north of the first half-mile mark, associated with fine hornblende schist. The belt crossing at about 1½ miles contains considerable pyrite and pyritous altered diabase, which is in close relation to bands of crushed granite. At 1¾ miles the magnetic variation is only 2° E., while 6° is the normal for the vicinity. Veinlets of quartz are found striking N. 80° E. and dipping 10° N. W. at three miles 20 chains a little north of the line; these occur at the contact of diorite belts with the country schists. A small quartz vein occurs at three miles 75 chains; this also is near dioritic rock. Some quartzite with pyrite occur near the eruption of quartz diorite west of lake 28. As usual in the Laurentian area, nothing of any economic value was seen, with the exception of some small masses of magnetite associated with quartz found near the 11th mile post.

Various small showings of minerals.

Near the contact on the southwest shore of Long lake some beds of fine pink and white felsite occur with a strike of N. 40° E. and dip of 40° N. W. The rocks in the vicinity are very much contorted, and the region may prove worth prospecting. At the point of contact on Thirty-Mile lake altered quartz porphyry occurs and masses of sericite schists with pyrites; also belts of a hard schistose rock, almost pure fine grained quartz with white mica, the whole crushed and sheared, and joined with a large mass of sericite with veinlets of quartz showing a trace of gold on assaying, followed by diorite and alternate bands of soft and compact schist striking N. 70° E. On the west shore similar rocks occur, particularly the hard, highly quartzose variety with light mica, but less sericite is found. On the small creek leading westward from Thirty-Mile lake schistose and dioritic rocks were found, with many interlaminations of quartz. In the belt to the southwest, composed of porphyrites, diorites and hornblende schists, numerous stringers of quartz were observed, an assay of which resulted in a trace of gold. No more quartz was observed in quantity until the shore of lake 43 was reached, where large masses of well mineralized sericite are seen with stringers of quartz, showing a distinct trace of gold on assaying, as also on the west side where the quartz occurs in reticulated veins.

Showings of gold in the Long lake and Abram's lake regions.

Just north of the point where the line falls on Abram's lake, in the sericitic rocks and slates, numerous bands of quartz are met with which gave on assaying a trace of gold. All around the shore of Abram's lake the mark of the prospector's hammer is seen. At a point about a half mile south of the line a vein is found in green pyritous schists striking N. 65° W. and dipping 31° S.W. which has been opened by prospectors and assays a trace of gold. Passing northeast towards the head of the lake, both on the shore and on the islands, much altered diabase is found interbedded with highly mineralized schists and permeated with small quartz veins. It was in this locality that the celebrated Golden Pocket was located from which some extremely rich samples were taken. I did not happen on it in my examination, but was informed of it at Dinorwic and saw an exceedingly fine specimen in the possession of Messrs. Ball and Douglas, who have done considerable exploration on Minnietakie and Abram's lakes. A vein occurs on the eastern side, near the head of the lake, being a distinct contact deposit with sericite to the north and hard pyritous schists to the south. This region and the territory towards lake 46 should prove as rich as any I have seen on the trip. On the west side of this arm a good show is seen about 20 chains north of the line, while numerous stringers are seen on

the point below. Around the second long point past the line a prospect has been opened by Mr. Alex. Livingstone of a number of lenticular veins, perhaps 10 in all, the largest about 10 feet wide, strike N. 50° E. and dip 30° N.W., carrying galena and pyrites assaying 1½ oz. of silver and a trace of gold. The country rock is soft hydromica secondary schists.

Gold on Pelican lake.

Just around the point from Pelican lake is another prospect in sericitic schists, N. 10° E., on which a vein of about a foot in width has been stripped for some distance. The island crossed by the line and those south of it are of an agglomerate nature, laminated N. E. 5° W., with some pyritous green schists. Southward along the west shore below the line is a prospect of reddish quartz in a hard and almost purely quartzose rock with light mica. A short distance below is a bald point of volcanic looking agglomerate or pyro-agglomerate, near the contact of which with some soft schists to the north is a series of veins which yielded on assaying $30 of gold to the ton. South of this agglomerate are dioritic rocks and slates, and to the southward point of the lake from this place were noticed numerous small veins with an average strike of N. 65° W., the largest being about 10 inches in width. On the east side of this arm to Abram's falls much less quartz was observed, but a claim has been staked by Mr. A. Botsford near the rapids, a specimen of ferruginous quartz from which yielded no gold ; the rocks in the vicinity are hard felsite schists and diorites. On the point of the narrows into Pelican lake the rock is of an agglomerate nature, in which location R110 is taken up, containing a vein about two feet wide with non-continuous walls and exposed for about 20 feet ; an assay yielded me no gold. Three chains south of 45 miles 65 chains on the south shore of Pelican lake is a prospect in hard clastic schists, with the inscription, "Ambooles, Oct. 12th, 1896, 80 acres," on a post. There is a main vein 14 inches wide striking E. and W., with several accessory parallel veins ; the country rock is well mineralized, but I observed little mineral matter in the vein stuff, which shows a trace of gold. On the shore of the second bay of Pelican lake to the south of the Sioux Lookout, wl itself fairly well mineralized throughou some small bedded veins of quartz of sight inches in width, apparently hori in position, associated with fine g dark green pyritous schists. Some v also occur near the Laurentian contact of which on the north shore of Pelica and on the shores of Lost lake noth importance was found. Directly east the lake from the Sioux Lookout l since learned that some rich claims been staked, but lack of time prol the examining of this stretch of line.

On the southern side of the Ver river, just beyond the first rapids, is

On the Vermilion waters, and westward on the Line.

tion marked BJ18, 80 acres a vein about four feet w quartz and quartzite miner The strike is E. and W. a dip 20° northward. The country ro pears to be partly fine quartzose schis extremely fine grained schistose diorite mineralized quartz assayed about $2 p There is also a claim adjoining this the east. On the north side of the nor of Vermilion lake, within two miles falls, two promising veins were ob striking east and west, the largest abo feet wide and tapering to points.

As observed under the head of G Geology, no specimens of quartz were ol between Pelican lake and Big Ver but as the country rock is essentially they may be met with there as elsewl the district. Close to the belt of described as passing near the inter with the fifth meridian some stri quartz were found an assay of which r in nothing.

A large number of diorite exposure found west of the intersection with a be feet of sugar quartz yielding nothing on ing, followed by numerous fahlband taining small veins of quartz. At abc miles and south of the line are ba schist with much magnetite and suga looking quartz. About a mile and beyond are small strings of quartz little hydromica schist. Nothing was in the Laurentian area west of lake 50

Fifth Meridian.

A visit was paid to the Ruby mine on Wabigoon lake, about three miles from Dinorwic. The country rock consists of fine schists, with examples of a hard compact nature, and also some of a softer, more micaceous aspect. With these is interlaminated in the form of lenticular segregations a large number of veinlets of quartz, constituting from 25 to 50 per cent. of the whole mass. Both quartz and rock are finely mineralized. The magnetic bearings are: Strike, N. 44° E., and dip 10° to 15° N. W., while the variation is 7½° E. Two shafts have been sunk on the property, one of which is closed, while the second, in which two men were working at the time of my visit, was down about 15 feet, being six feet by eight and cribbed for about six feet. Some claims have been located in the vicinity of Taché, none of which were seen.

Ruby Mine near Dinorwic.

Near the mass of porphyritic granite west of lake 75 is a vein of quartz four to 10 inches wide, also on the north shore of lake 81, with schistose quartzite and micaceous and hornblendic schists.

The succeeding granitic area as usual is barren, but in the Huronian rocks beyond indications were found at the following points: On Big Sandy lake, quartz in sericite. At 10 chains east of 73½ miles, altered quartz porphyry and fine grained schists, with quartz veinlets. South of lake 87, mineralized hornblende schist with quartz. Ten chains west of 74 miles occurs a hard white quartzose schist well mineralized, with bands of quartz and quartzite striking N. E. and S. W., and crossing the line at 15 chains in the 75th mile. East of 74¼ miles is some sericite with quartz. On lake Minnietakie, near the line, the rocks are for the most part the hard schists and porphyrites, with some sericite, which is more common farther to the east, where Mr. Williams has located a claim showing several veins of about a foot in width, striking S. 30° W.; the dip is difficult to ascertain. This long arm of Minnietakie lake is said to yield gold at various points, as likewise the larger bay to the south. Messrs. Harvey and Hart have established a permanent camp on the northern bay and are exploiting several claims at various points on the lake. They have some promising specimens carrying galena and pyrite, and kindly invited me to see the properties, but lack of time prevented my doing so, as well as the shores of Minnietakie in general. Stringers of quartz also occur north of the lake in hard schists and porphyrites at 20 chains in the 78th mile, and also at 14 chains in the 79th, where they are one to two feet wide, striking N. E. with the strata. At 24 chains in the 80th mile a large mass of quartz crosses the line N. 40° W.; it is very sugary at the south side, but is about 50 feet wide and more crystalline towards the north. An assay resulted in a distinct trace of gold.

Indications in the Huronian tract.

Mr Whiting has established a mining camp near the outlet of Whiting's lake, from which he has cut several wide trails in order to systematically prospect the region; also a clear trail due east to connect the above lake with Minnietakie, and to enable him to bring in the necessary supplies. Five hundred yards west of the camp is a schistose gray rock with stringers and blotches of quartz, becoming an agglomerate towards the west. The next ridge beyond shows also an agglomerate rock on its eastern flank, but is more schistose westwardly, with numerous strings of quartz.

Whiting's mining camp.

To the northwest of the camp the following series is presented: Hard felsitic schists, succeeded by quartzose micaceous schists and three feet of crystalline ferruginous quartz, with trace of gold; also bands of quartzite with crystals of magnetite and pyrite. Beyond is a hill of fine white rock, almost pure quartz in extremely fine grains, when broken across the stratification resembling a fine white quartzite, but parallel to the parting planes showing pearly mica. On the surface this rock weathers white owing to the decomposition of the mica, and proving this mineral to be distributed throughout the mass. This hill, as also a similar one southwest of it, are fairly well mineralized: and have bands of quartz running through them.

On the small creek from Whiting's lake is a vein three feet wide striking S. 70° W., with a dip of 40° N. W., which has been traced for about 300 yards. This also is mineralized, as well as the green schist forming the country rock. A little farther down the stream a

belt of schists cross its course which are very highly mineralized, seams of four inches being almost pure pyrites owing to the decomposition of the surrounding matrix.

On the west shore of the lake also, several approximately parallel veins are found, striking N. 50° E. and dipping 30 N.W. They average 10 feet in width and traverse well mineralized rock. Six assays in all were made from Mr. Whiting's prospects, but only a trace of gold was found in any of them; however, the region being so well mineralized it is certainly worth a careful exploration.

Maskinonge and Vermilion lakes.

Between Maskinonge and Vermilion lakes some small stringers were observed at various points, but this particular region does not look as promising as most of the Huronian areas. The small island crossed by the line in Vermilion lake shows fine micaceous schists with mineral and splashes of quartz: the same rock occurs on the mainland west of the line on the north shore, where it contains veins of quartz. Continuing along this shore were found belts of diorite with brownish quartz at the contact and hard white and green quartzose schists, while in the bays at the southwest extremity of the lake very highly mineralized pyritous shales were seen, with an east and west strike, dipping 50° north and yielding a trace of gold on assaying.

At the 91st mile post pyritous schistose diorite with quartz was observed, and 15 chains beyond a decomposed hornblende epidote schist with quartz, followed by bands of hornblende schist heralding the Laurentian contact.

Besides the assays hitherto mentioned the following were made: From Wabigoon lake, O'Brien and Kennedy's property, a trace. From near Sioux Lookout, Mr. Livingstone's property, 4 oz. silver and $2 gold. From Adams lake, Mr. Livingstone's property, 11 oz. silver and $1 gold.

Aluminium sulphate.

I had been informed by Mr. Williams, the Hudson's Bay factor at Lonely lake, that certain islands in the lake contained deposits of aluminium sulphate. A search was made for these deposits, but with no result. It is quite possible however that such a formation should exist, and it could easily be accounted for by the decomposition of the pyrite in one of the numerous pyritous bands to sulphuric acid and its subsequent conversion into the above mentioned sulphate.

General Conclusions.

Probabilities of the Region.

Speaking generally, it may be said that the whole expanse of Huronian rocks in the region carry gold for the most part in small quantities, but occasionally becoming more valuable. It will also be understood that the samples assayed were necessarily small surface chips. It may also be concluded that the agglomerates are the least likely rocks, the mineralized green and gray schists the next in order, while the soft sericitic rocks are most favorable for the occurrence of the precious metal. Also it may be noted that the very highly mineralized bands, those in which the pyrite plays a prominent part, are not necessarily rich in proportion to the amount of pyrite, but rather the reverse. The rocks very much resemble Lawson's Keewatin series to the south of the railway on Lake of the Woods; and I am aware of no geological reason why this district should not prove equally rich, although there is no guarantee to that effect, for the same rock in different localities may be entirely different in its mineral contents.

Timber and Agriculture

Along the Fourth Meridian Line.

South of lake 4 on the fourth meridian the timber is mostly scrub, with tamarac in the swamps, but to the east and north of that lake a spruce belt extends to Victoria lake and stretches westward a distance of two miles to Indian lake and an unknown distance to the east. This belt contains 20 or 25 square miles of red spruce, with some birch and an occasional pine. The largest trees are 16 to 18 inches diameter, but the average of all is not more than 10. Within this area are some stretches of clay soil that may prove useful for agricultural purposes.

North of Bear lake to Thirty-Mile lake the timber is essentially similar, consisting of spruce on the level fairly dry land, scrub spruce, tamarac and cedar in the swamps

and pitch pine on the highlands, with white birch and poplar on the sandy areas near lakes.

The best spruce on this meridian is found in the vicinity of the rapids out of Elephant lake, some trees reaching a diameter of 20 inches. No recently burnt land was seen, but evidences of a pine forest of 50 or 60 years ago were numerous.

Fourth Base Line.

In the region surrounding lake 20 and for a short distance west both the boundary and the base lines traverse a recently burnt tract. The point of intersection lies within a large burnt area stretching to the northeast. Scrub spruce with some cedar in the swamps extends to the fourth mile post, and north of here is another burnt area. From this point to Lake of Bays pitch pine is common on the high lands, while somewhat larger spruce and poplar occupy the depressions. West of this lake for about a mile are spruce, poplar, birch and balsam, and near the first crossing of the river is a considerable stretch of tamarac swamp. Around Dominion lake occur belts of open forest with pitch pine and spruce, while a prominent sand ridge crosses at the 20th mile with fair sized pitch pine, followed by a spruce area a mile to the south. This sweeps to the southwest with a large scrub spruce swamp on its northern flank reaching across the line.

Areas of burnt and timbered lands.

In the vicinity of lakes 35, 36, 37 and 38 fair sized spruce occurs, passing into pitch pine on the higher land to the east of Long lake, on the opposite side of which heavy spruce (14 to 16 in.) extends to lake 38 and on the line to Thirty-Mile lake. South of the line however on the shore of this lake a burnt area occurs, the eastern limit of which sweeps in a curve to the S.E., bending southwest north of the bay of Long lake crossed by the meridian. This tract appears to be recently burnt, as many trees are still standing, notably east of the lake, while on the west side the line continues in the brulé which passes into green bush about a mile to the south. The line again enters the spruce timber near the 33rd mile post north of which for a mile it continues, but beyond is another burnt tract of earlier date. The southern part of lake 39 is burnt, but green timber follows the shore to the north. The burnt land continues around lakes 41, 42, 43 and 44, making the walking extremely arduous.

Around Thirty-Mile lake, and west of it.

From the high hill west of lake 44 the country is seen to be burnt far to the N. N. E. and S. E., while it is green a few miles off to the west and southwest. From this point of view it appears that the fire has followed a direction of N. 10° W. in a belt about 15 miles in width. Forest fires were seen to be burning at the time of observation (July 15) at the following points:

Forest fires.

N. 85° W.	5 miles	S. 80° E.	15 miles
N. 50° W.	5 miles	S. 35° E.	10 miles
N. 25° W.	10 miles	S. 50° W.	8 miles

The western limit of this area comes out on Abram's lake about a mile north of the line, while poplar and birch follow the shore to Abram's falls and for some distance east on Minnietakie, passing into fair sized spruce timber around lake 45. A well wooded area stretches from Pelican lake westward to Vermilion lake and on the shores of Pelican lake for the most part. A few isolated white pines stand sentry over the passage into Lost lake, where a small grove has withstood the great enemy to the forests of our country.

Timber of Abram's, Minnietakie, Pelican and Vermilion lakes.

All is burnt around lakes 48 and 49, continuing to lake 51, where the line again enters a green forest of pitch pine and spruce of 10 to 12 inches diameter. After having spent about two weeks continuously in the brulé, it was a great relief to foot and eye to again feel the thick, soft moss and to see the shade of the dark green spruce forest. On an upland of coarse sand before entering the timber, nature is seen at work recovering the desolate area with green, for thousands of small pitch pines of three and four inches in height are appearing among the charred logs.

Fifth and Sixth Meridians.

Very little can be said of the timber west of the fifth meridian; it is the usual succession of spruce, pitch pine, tamarac, birch, poplar and balsam, which obtains to near the intersection of the sixth meridian, near which another

On the Sixth Meridian Line.

brulé occurs sweeping down the line and around the western shore of Pelican lake, following the Pelican and Wabigoon rivers and reaching to the railway. Throughout the whole 90 miles of the base line no considerable area of land suitable for agriculture was met with. But, as is well known, in the area around Dryden and north and west down the Wabigoon and up the Pelican river a good mantle of clay offers excellent inducements to agricultural settlers, many of whom are now located at various points along the rivers and on the roads being built through the townships of Eton and Wainwright. It may be observed in this connection that the Indians at Frenchman's Head on Lost lake have small gardens neatly fenced and cultivated, in which are growing potatoes, cabbages and onions.

Farm lands at Dinorwic.

As observed in the Surface Geology, the little village of Dinorwic is situated in a clay area extending for about five miles around it, which appears as well suited for agriculture as the Dryden district. A pioneer garden has been cultivated by Mr. Prewer, the Episcopal missionary, in which corn, potatoes and cabbage were doing well at the time of my visit in August. This little village promises well ; two years ago only two white men inhabited it, but now 20 or 30 buildings with a commodious hotel form the nucleus of what must become a thriving town if the mining development continues in the Minnitakie region, as it forms the natural base of supplies, being situate on the long portage from the Mackenzie river to Big Sandy lake, over which go all the Hudson's Bay supplies to the far north, and which will also form the means of access for mining machinery and provisions to the auriferous districts.

Wagon road to Sandy lake.

A burnt belt extends along the wagon road and around the south and west sides of Big Sandy lake, but green timber of a rather stunted nature covers the country on the line for about four miles, followed by a district through which violent storms from the west have levelled the timber over many square miles, making travel even worse than in the burnt districts. This condition does not prevail however far to the west, as spruce and pitch pine forest of 16 to 18-inch trees is found about west of the line at 66½ miles.

On the line at 67 miles green bush appears, passing into an old brulé with

Along the Fifth Meridian Line.

spruce, tamarac and pitch 67 miles 28 chains, which tinues around lake 87 and as the line as the 69½ mile post. The timb is spruce of fair size, continuing t lake, and with some interruptions to M takie, north of which lake howev country is burnt, with an occasiona of green timber, as on the south s Maskinonge lake, clear through to th of the line at the Indian reserve. area just north of Whiting's lake and a between Maskinonge and Big Ver might prove useful for farming purpos their extent is limited, being in no large enough to warrant the laying ou township.

General distribution of spruce timber.

To sum up this part of the work, it n said that with the exception of the indicated at Dryden, Dinorw Indian lake, and the patches referred to, the country can prove an agricultural region. No pine except a few isolated trees, but ple spruce of fair size is universally distr over the unburnt districts. This prove excellent pulp-wood, or would se other purposes to which the timber is ed ; the great difficulty would be in d the logs to the front, as all the waters region belong to the Hudson Bay slope

Petrology of the Count

Mineral species of the Huronian areas.

The rocks of the Huronian areas p throughout evidences of intense metan ism, including crushing, sh and chemical and minera alteration. In some place weathering has proceeded to such a that it is impossible to determine the o nature of the rock. In the followin will be found a short description of a n of rocks which, with minor variation embrace all the species met with.

Hornblende schist. Dark gray or rock, light green when much altered, m less schistose in structure ; to the nak in many cases homogeneous, in others sl

led with white. Some varieties show patches of fine granular quartz. Com- . of hornblende and quartz.

.site schist. Hard light or pinkish :ose rock, very fine grained with occa- l dark spots. Felspar, quartz and a biotite or hornblende.

›rite schist. Dark green schistose rock, ›me cases homogeneous, in others led ; resembles the hornblende schist 'eathers lighter and more easily. Horn- e and plagioclase.

lorite schist. Light green schistose resembling hornblende schist, but ' and more earthy-looking on fresh ing. An altered hornblende schist or se. Chlorite and quartz.

'icite schist. Soft, light-colored and mely schistose, cleaving easily. Shows ny places white blebs, frequently with gers of quartz ; on hillsides presents or less vertical faces. Sericite (hydro- and quartz.

artzite. Hard fine-grained compact rock, or dark in color, composed essen- of quartz. In one case it contained ite.

:a schist. Dark gray rock, generally rained ; occurs with Laurentian gneiss ear contacts. Quartz and mica.

›rite. Generally dark green and com- where coarse, the white part weathers rst, turning to soft white powder, which erve to distinguish it from hornblende . Hornblende and plagioclase.

artz diorite. Like above, but contains z. In the field somewhat resembles blende granite.

.base. Resembles diorite, but the fel- is in the form of needles ; originally ›sed of augite and plagioclase. In all the examples but one the augite was entirely altered to hornblende.

Quartz porphyry. White angular patches in a darker ground-mass. Consists of crystals of quartz and felspar imbedded in a ground-mass of the same minerals ; generally much altered, passing into schists.

Porphyrite. Dull stony rock, with decomposed felspar and hornblende, the former frequently porphyritic.

Altered diabase. A rock of hard, fine, gray, compact nature ; was found on microscopic examination to show the lath-like structure of diabase, in which the felspar and augite are completely disintegrated.

Phyllites and clay slates. Dark gray slate-like rocks with pronounced cleavage. Argillaceous matter with quartz and other impurities.

Agglomerate. Rock containing rounded fragments of pre-formed material cemented by a fine-grained matrix. Inclusions sometimes a foot in diameter. The rocks are in this region probably of volcanic origin.

Granite. Pink and gray varieties were met with, depending on the color of the felspar. Orthoclase, quartz and mica.

Hornblende granite. Same as above, but with the mica replaced by hornblende.

Crushed granite. Through intense pressure the granite has lost its granular appearance ; the felspar is much altered and the quartz broken, while the mica generally appears as undecided dark spots or streaks.

Gneiss. Same composition as granite, but showing more or less schistosity, varying from distinct bands to mere rough parallelism of the mica flakes. Gray, pink, red and other varieties occur of different degree of fineness. In many places it is impossible to distinguish between this rock and granite.

Michipicoton Mining Division.

By Arthur B. Willmott M A B Sc

Introduction

IN PURSUANCE of instructions from the Director of the Bureau of Mines I left Toronto on September 10, 1897, to make a geological examination of the Michipicoton Mining Division.

The district may be reached either by steamer from Sault Ste. Marie or by the Canadian Pacific Railway. I chose the latter route, and found myself in Missanabie 21 hours after leaving Toronto. The villagers I found were considerably excited over the recent gold discoveries. A number of exploring parties had already started from there, and others were arriving daily. Canoes and Indians were at a high premium, and for a time none could be got.

Toronto to Missanabie Station.

For some time a little prospecting had been going on in the Michipicoton district, but no valuable discoveries had been made. During the early summer an Indian known as Teddy or Thaddy showed specimens of quartz carrying free gold at Missanabie. For a consideration he pointed out to James Dickinson of North Bay the situation of the vein on Wawa lake. Samples were obtained and rich assays were the result. On the first report parties hurried into the district from Sault Ste Marie and were successful in locating other veins carrying free gold. Their glowing reports were the foundation for most sensational articles in Canadian and American journals, many referring to the district as another Klondike. Men began to arrive from all quarters of the continent, and even women came into the district as prospectors.

History of the excitement.

A second report that placer gold had been found caused still more excitement. Several parties claimed that they had found traces of alluvial gold, but Mr. C. I. Amey of Ottawa was the first to show specimens. On my reaching Missanabie Mr. Amey showed me specimens of gold which he claimed to have panned from the bed of a creek south of Manitowick lake. The nuggets varied in size from a grain of wheat downwards, were waterworn and were exhibited in a small vial filled with magnetic iron sand. It was chiefly on Mr. Amey's statement, backed up by these specimens, that the reports of placer gold had already been so widely circulated not only in Canadian newspapers but throughout the United States. It is fair to Mr. Amey to state that he had not intended to give publicity to these reputed placer finds, and he seemed surprised when I told him that what he was telling me in confidence had already been published in the Toronto papers. I examined the specimens closely, Mr. Amey remarking that I need not be suspicious, for they were genuine, and so far as I could tell they were. Two weeks later I visited the locality. On my return to Missanabie, in the absence of Mr. Amey, I told his man that I believed the gold had been planted. He confessed at once, telling me the nuggets had been taken from quartz which probably came from the Dickinson claim on Wawa lake. The sensational accounts are thus all founded on the surface appearance of the Dickinson claim and a few others near by.

Reports of placer gold.

Many prospectors, utterly unfitted for their duties, were induced to go into the district by these glowing accounts. Unused to bush life, unable to canoe, often not knowing quartz when they found it, it is not surprising that many quickly left. Unfortunately they told their friends that there was no gold in the country, when they should say that they failed to find nuggets on the shores of the lakes which could be shovelled into bags without getting out of their canoes.

A rush of prospectors to the region.

The excitement however brought other

classes of men; some of them old prospectors, others with experience of bush life or with plenty of grit. Many of these made 'finds' and still more of them were convinced that the district was well worth prospecting.

The Mining Division

The Mining Division as declared by an Order in Council of September 9, 1897, embraces a tract of about 5,000 square miles, "limited upon its east side by the meridian of the east end of Dog lake, or say 84 degrees west from Greenwich, on the south side by the latitude of Cape Gargantua, say 47 degrees 36 minutes, on the north side by the latitude of 48 degrees 30 minutes, and between the westerly ends of these lines of latitude, where they touch lake Superior, by the shore of said lake."

Extent and boundaries of the Division.

As shown on the map, the greatest length of the Division, that of the northern boundary, is 103 miles; the greatest width is 64 miles. The northeastern corner is traversed by the Canadian Pacific Railway from near Carry siding to near Amyot station, a distance of about 60 miles.

Missanabie, a railway station 232 miles west of Sudbury, is the seat of a Hudson's Bay Post. Situated on Dog lake, with canoe routes leading southwest, northwest and northeast, it is a convenient point for a prospector to outfit.

Grasett, 36 miles west of Missanabie, is a telegraph station, and supplies can be forwarded there by those intending to reach the heart of the country by way of the Magpie river.

Accessibility of the country.

A third means of ingress, and so far the one generally adopted, is by steamer from Sault Ste. Marie to Little Gros Cap harbor on lake Superior, a distance of 125 miles. In this case supplies must be brought with one, as the old post of the Hudson's Bay Company at Michipicoton is now closed. The steamer which runs in connection with the fishing stations along the shore of lake Superior makes two or three trips weekly. These fishing stations to the west of Michipicoton are also convenient starting points.

Ways of Entrance

Canoe routes, the railway and the coast line of lake Superior make the country fairly accessible. The last extends for about 140 miles in a northwestern direction, and the smaller sinuosities probably double the number of miles of exposed rock. The railway is here fairly parallel with the coast at a distance of 45 to 70 miles. From both the coast and the railway streams and lakes afford canoe routes to the interior. Most of these are comparatively short. Three routes are however possible from the railway to the coast, all of which end at Michipicoton. Two of these routes start at Missanabie, 46 miles in a direct line from lake Superior. They proceed in common in a southwestward direction through Dog and Manitowick lakes. Thence one follows the Michipicoton river around one-third of a circle to its outlet, a probable distance of 60 miles. There are on this route six portages, all well travelled, but some of them very rough. The Big Stony portage is five-sixths of a mile long, and the Long portage one mile and three-quarters. The others are short. Below the Long portage the river winds about in a gravel plain for nearly 10 miles, with considerable current, making it necessary to 'pole' in many places when ascending. For this reason, and because of its shortness, the route which diverges from the lower end of Manitowick is usually taken. This ascends a small stream in a southwestern direction, passes through a number of small lakes, over the height of land and down Wawa lake to its southwest end. Thence an old Canadian Pacific construction road may be taken to Michipicoton, a distance of five miles. At the time of my visit two teams were transporting goods across the 'tote-road' to Wawa at exorbitant rates. This route from Missanabie is very direct—little over 50 miles—and can be made in two days by two men travelling in a light canoe. The portages are numerous but good, except the Big Stony one.

Canoe routes to the interior.

The third canoe route is down the Magpie river from a point five miles east of Grasett, on the line of the railway; or a slightly

roundabout route may be taken from a point one mile east of the station. A straight line to Michipicoton measures about 44 miles, but the windings of the stream increase this to about 60 miles. Except at the upper end, the river flows through gravel plains, and at scores of places will barely float a canoe in September. The descent is 534 feet, and as there are only six important falls the river is a constant succession of currents which cannot be paddled up. Thirteen portages were made descending the stream, but the number would be much greater in ascending it. Two days' good paddling with a light load will bring one down, but four are required to return.

At the time of the construction of the Canadian Pacific Railway roads were built by the contractors for the purpose of getting in supplies. Though these roads are now overgrown with small brush, and the bridges across the creeks have decayed, they afford to the prospector a comparatively easy entrance to the interior.

Starting at Michipicoton, the main road ran five miles northeast to Wawa lake, where a steamer was used for six miles more. From the east end of this lake one road ran north to near Grasett station, a distance of 38 miles in a straight line. The main road continued northeast for 14 miles to Manitowick lake, where another steamer was in service. This vessel plied to the northeast end of the lake, where a tote-road two miles in length was built to Dog lake. A third steamer was in service here. From the northeast of Manitowick another 'tote-road' extends east to Dalton station, about 20 miles. While these roads are at present only of value to the prospector, in the event of active mining operations they may be of great service in getting in machinery, as at a comparatively small cost good winter roads can be made of them.

In travelling through the country I found Dr. Bell's map of the Basin of Moose River and adjacent country (published by the Geological Survey in 1883) to be of great value. The accompanying map is founded on this one, with such additions and corrections as I have been able to make. There are some changes in geological coloring, for I have classed all large bodies of gneiss and granitoid gneiss as Laurentian, even where they appear to be later than the green schists they accompany.

Map of the Division.

The map was drawn for photo-lithography by Mr. D. G. Boyd, Inspector of the Division. Dr. Bell's map enlarged 16-fold forms the basis. To this has been added the surveys along the line of the Canadian Pacific Railway, Salter's base line run east from Michipicoton, Herrick's line, and surveys of mining claims, the originals of all of which are in the Crown Lands Department. The coast of lake Superior is enlarged from Bayfield's chart.

The present variation of the compass at Michipicoton is 2° 16′ west, and this correction has usually been made in giving strikes.

Literature.

Papers and Reports on the geology of the Division.

The following list of papers and reports dealing more or less with the geology of the Michipicoton Mining Division is given here for convenience of reference:

Rep. Geol. Sur. Can. 1846-7. Logan's description of the conglomerate at the mouth of the Doré, p. 10. Rocks of the coast, 25. Sandstone at Capes Choyye and Gargantua, 31. Murray on the Michipicoton river.

Lake Superior, its Physical Character, Vegetation and Animals. Louis Agassiz, 1850.

Geol. of Can. 1863. Section of Huronian slates at the Doré, 52. Sandstone at Gargantua, 53. Native copper at Gargantua, 703. Copper pyrites at Michipicoton bay, 708.

Rep. Geol. Sur. 1866. Macfarlane, Lake Superior rocks. Hematite at Little Gros Cap, 130.

Rep. Geol. Sur. 1870-1. Bell, Pic and White rivers.

Rep. Geol. Sur. 1875-6. Bell, Michipicoton river, 331, 335.

Rep. Geol. Sur. 1876-7. Bell, Lake Superior, Gros Cap to Gargantua, 218.

Rep. Geol. Sur. 1880-1-2. Bell, Rocks of the Michipicoton river and Dog, Oba and Magpie lakes. Geological map.

Am. Geol. XX. 126. Taylor, Dog lake not an outlet of Superior.

Minn. Geol. and Nat. Hist. Sur. XX. 1891. Lawson, Beaches at Dog River.

Bull. Denison Univ. II pp. 119-143; with four plates. Herrick, Tight and Jones, Geology and Lithology of Michipicoton Bay.

aversing the Region

nabie is situated on the north shore lake, 675 miles west of Montreal. The village consists of a dozen buildings situated on both sides of way track, which forms the only The name, which has been variously by different explorers, is now written e on the authority of the railway r. Mr. Ross of the Hudson's Bay y informed me that the name meant in the Water, the reference being old Indian pictures on a cliff which cted from the water.[1]

nabie is the starting point for Bruns- ouse and Moose Factory. The canoe over the height of land into Crooked ie headwaters of the Missanabie of the Moose river. The distance in it line is 235 miles, but the sinuosities route increase this to about 275. to 20 days are taken for the trip the Factory. Supplies for Bruns- ouse are now sent in this way instead oose.

Missanabie to Michipicoten.

iorning of September 11 was spent ing supplies and engaging canoemen. Through the kindness of Mr. S. P. Ross, the Hudson's Bay factor, I was able to procure two first-class bark canoes and two very experi- ndian guides, George Sanders and Quackageesick. Both proved very canoemen and packers, and George l to the cooking in a very fair man- i the afternoon I went with Mr. C. y, a prospector from Ottawa, to a location taken up for anthracite Through the kindness of Mr. Ken- iperintendent of the C. P. R. for this , we were carried 3½ miles west on a train right to the location. The e which Mr. Amey had supposed to I found to be a narrow seam of ne, and utterly useless I learned on rn to Toronto that Dr. Coleman had his claim earlier in the summer and orted on it.[2]

On Sunday morning I was joined by Mr. Wilson Blue of the staff of the Toronto Globe. Mr. Blue proved a genial travelling companion, a good canoeman and packer, and saved me the expense of a third canoeman. Ten days later at Michipicoten I was joined by Mr. John Miller of Toronto. Mr. Miller had his own outfit and servant, and was bent on pleasure. A number of views taken by him have been photogravured for this Report.

The following morning I accompanied Mr. W. A. Lunan of Thornbury to a claim west of Missanabie, which was not yet patented. A vein of quartz six inches wide was stripped for a few yards, and an irregular mass was exposed on the side of a low knoll. A sample taken for assay yielded only a trace of gold. The wall rock consisted of hornblende schist striking 70°.

While at Missanabie I was shown a specimen of magnetite from 30 miles south of Chapleau. The bed is said to be four or five feet wide and to assay 68 per cent. iron. Mr. Thomas Lonahan of Missanabie is one of the owners. I was also shown graphite from Otter grade on the C. P. R.

Dog lake and its tributary waters.

Dog lake is an irregular body of water eight miles in length from the most northerly to the most southerly point and 12 from east to west. The northern arm, formerly known as Mattagaming lake (Branch in the Lake) is now called Loch Alsh, from the C. P. R. siding of that name. This arm receives the waters of Wabatongusheen lake, the headwaters of the Michipicoten river. From Missanabie an irregular arm extends east to the height of land, six miles in a straight line. According to Dr. Bell[3] the height of land portage is low and level, and only 356 paces long. Crooked lake, the headwater of the Missanabie branch of the Moose river, is said by him to be about 12 feet higher than Dog lake. Taylor[4] states that "the trough in which Dog lake lies is one of those curious deep rock-walled valleys that cross the wide, low crest of the Laurentide ridge at many places. Into this valley near the head of Dog lake a small stream comes in from the eastern side, and the present division of the

lso Bell, Rep. Geol. Sur., 1877-8, p. 3C.
, p. 136.

[3]Geol. Sur. Can. 1875-6, p. 331.
[4]Am. Geol. XX, p. 126.

waters is determined by the low, broad delta which has been built up since glacial times." The height of this col is given by Taylor as 515 feet above lake Superior, but this is probably a little too high. Dog lake, according to the profile of the Canadian Pacific Railway as furnished me by Mr. White of the Geological Survey, is only 489 feet above Superior. Two aneroid determinations which I made are not quite satisfactory. Travelling by the Michipicoton the total fall at rapids is 362 feet. To this must be added the fall in 28 miles of river which I estimate to be 112 feet. Dog lake is thus 474 feet above Superior. The other determination made by way of Wawa, and in which considerable reliance may be placed, makes Dog lake 532 feet above Superior. For both determinations Manitowick is taken to be 119 feet below Dog lake.

Altitudes.

It has been considered possible that lake Superior when at a greater height may have flowed northward into Hudson bay through this Dog lake pass. Taylor has given his verdict against it, and I saw no evidence in favor of it. I did not have time to go up the eastern arm of the lake to the height of land. Some prospectors informed me that they had discovered quartz of some promise on Crooked lake, near the contact of the Huronian and Laurentian, as shown on Bell's map.

Dog lake Pass.

Missanabie is situated on Laurentian gneiss, but a short distance to the west the green schists are found. Travelling south along the east shore of Dog lake I noticed agglomerates at a distance of 3½ miles. The strike of this rock was 45° A few yards farther south red granite was seen. Two and a half miles to the southwest fragments of hornblende schist are included in the granite. The granite passes insensibly into undoubted gneiss farther to the south and continues nearly to the foot of the lake. I coasted the west shore of the lake on my return and found it to consist of Huronian schists. At the lower end, where the two shores approach, the schists are cut by granite dikes, but with wider separation of the shores to the north this is not the case. The western end of Waboose or Big Rabbit island consists of Huronian schist The eastern end is an intrusive mass of gneiss. The line of contact of the two formations thus runs in a southwest direction for the most part down the centre of the lake.

Rock formations of Dog lake shores.

There are many beaches of gravel and boulders along the shore, made by the reassortment of glacial debris. At our noon camp eight miles south of Missanabie I found the elevation of a prominent hill to be 60 feet above Dog lake. This seemed to fairly represent the altitude of the country for miles around. Low rounded hills with intervening gravel and sand plains scantily covered with birch and poplar is the typical scene. Blueberries were still in their prime at this late date.

On Michipicoton River.

The Michipicoton river on leaving Dog lake plunges over a rocky barrier of Huronian schists. Two aneroid determinations, made two weeks' apart, agree in making the fall 14 feet. The rock is mainly chlorite schist, though some agglomerate is seen. The strike at the portage is 10°. The Little Stony portage on the northwest side is about four chains in length and very good.

Michipicoton river.

In a bay to the east of the outlet the old tote-road to Manitowick lake came out. A decaying wharf and steamer are the only indications of the once busy thoroughfare.

Below the portage there is a large mass of irregular lenses of quartz visible in the river bottom. This was said by the natives to have been taken up as a location years ago, but no record of it exists in the Crown Lands office.

The stream is boulder-dammed about three-fourths of a mile below, and here the Big Stony portage begins. The portage is on the east side and is about five-sixths of a mile long, taking 25 minutes to cross with a pack. The upper part is over a moraine consisting of stones two to four feet in diameter, which make a very rough path. The lower end crosses a deposit of finer material. In this the stream has excavated a channel in some places 40 feet deep. This part, about one-third of the whole, may be run by light canoes. Several

Big Stony portage.

tors panned these gravels, but found
;. The average of two aneroid read-
ows the fall to be 104½ feet, and
wick lake to be 119 feet below Dog
A considerable part of the fall is in
over ledges of schist.

towick[5] lake lies in a narrow valley
g to the northeast, and is enclosed by
ills. The main body of the lake is 10
ong and about one mile wide, but at the
ck upper end for two miles it does not
average more than a quarter of a
The ou let at the lower end is not
he valley but across the ridge into a
l valley, which is obstructed by glacial
a mile below. In this way a subsi-
ake has been formed 2½ miles long and
nile broad, connected with and form-
t of Manitowick.

p rocky shores characterize the lake,
at the ends. At the upper part, where
ns, there is a large sand beach through
a creek 10 feet wide finds its way.
fluence of sand bars is here shown very
on a small scale. The creek, after
ng a point 15 feet from the lake, is
to flow 100 yards to get through.

n this point the old construction road
stward to Dalton. I spent one morn-
ploring the region, travelling in as far
e would permit. For two-thirds of a
or as far as the first lake, the trail is
This lake is a little over a mile long,
and shallow. The road is much over-
grown with willows and travellin
oad. is slow. From the first to the
lake is about five or six chains. This
a little over a quarter of a mile long
uite close to the third, which is half a
ong. It would not be difficult to port-
this way. The road around the west
of the second lake is very rough and
and around the third lake it is not
better.

onian rocks are found thus far. At the
ake the strike is 18 ; opposite the first
is 128° ; a little farther in, 118 . The
t with the gneiss was not reached, but
robably not much farther inland. Hills
250 feet above Manitowick are all
around. Most of these have been burned bare and are easily prospected. Diabase was most frequently met ; bands of felsite and agglomerate occur. Considerable float quartz was seen, and also some small lenticular seams. Some pannings in the bed of the creek gave no results.

Subsequently to my visit a claim was staked on the east side of Manitowick, about two miles southwest of the tote-road, by N. J. Dingman of Palmerston. Mr. Dingman, whom I met at Michipicoton Post, was very enthusiastic over his claim. He described it as a vein of quartz exposed along the face of a cliff several hundred feet high. The vein runs to the northeast, following the formation, and dips slightly to the southeast (?) into the cliff. Fine gold was found in places. Pyrite, pyrrhotite and galena are found in the quartz. Four assays gave $0.50, $9, $13 and $26 respectively. The first was partly country rock and the last contained free gold.

Dingman's claim on Manitowick lake.

The northwest side of Manitowick has been burnt, but the southeast is still green. Spruce, balsam, birch and poplar are the prevailing trees. Tamarac, cedar, balm of gilead and black ash are also found. The mountain ash with its brilliant red berries occurs very frequently in single individuals. High cranberry bushes are found in the moist places.

Forest trees and rock formations.

About two miles southwest of the tote-road (on a point marked 81 on Bell's map) there is a small area of quartzose gneiss. South of this to the outlet, the east shore of the main lake and both shores of the smaller bay consist of a red biotite granite, with only a slight trace of stratification. At Pigeon portage, 1½ miles south of the outlet, the rock is a gray gneiss very indistinctly stratified. At both localities the rocks are cut by numerous dikes of diabase. Dr. Bell has mapped the rock on Manitowick as Huronian, and that at Pigeon portage as eruptive granite. Except in color there is no difference, both rocks being granitoid gneisses. Moreover the gneiss of Pigeon portage is continuous with and exactly resembles the gneiss south of Whitefish lake, which was mapped as Laurentian. For these reasons, and because the southwest shore of Manitowick is also gneiss,

ian for a blue serge cloth sold by the Hud-
ay Co.

I have mapped the country south of the centre of Manitowick as Laurentian.

At the west end of the bay at the south of Manitowick is a sand plain through which the stream meanders for fully two miles before reaching Pigeon rapids. The portage on the east side is very stony, and takes seven minutes to cross with a pack. An aneroid reading showed the fall to be 18 feet.

Pigeon portage, and the hills around it.

Steep hills lie on either side of the portage. One on the east I found to be 341 feet high. In the early morning, while the sun was but touching the tops of the surrounding hills, it afforded a beautiful though not extensive view. In the valleys at the foot all was yet enveloped in mist. To the north one could see the southern arm of Manitowick and the channel into the main body. On the east of the hill was another lake, about a quarter of a mile long and bearing a little west of north. Across this lake and nestling on the hillside was still another lake, recognized only by the column of vapor rising among the green trees. Southward the course of the river could be traced only by the mist. The hill itself is but scantily clothed with trees. Granitoid gneiss is everywhere, though sometimes hidden beneath a mossy covering. At one point a dike of diabase 10 to 15 feet wide cuts across the gneiss in a direction 10° west of north. Across the stream was a similar hill, well covered with forest, the upper part of which one could see resplendent in the golden hues of autumn. It was disagreeable to leave the warm sunshine and scramble through the wet shrubbery down into the cold foggy valley.

At the foot of Pigeon portage is Whitefish lake, here a river-like channel about five chains wide, bearing 170°. Shortly it widens to 10 or 12 chains and then bears 200°. A creek comes in at the northeast angle. A mile and a half south a dike of diabase five feet wide cuts through the granitoid gneiss in a course bearing 160°. Further south another dike bears 110°. Whitefish lake is in a narrow valley between hills 200 to 350 feet high. On both sides the rock is an indistinctly stratified granitoid gneiss.

Whitefish lake.

At the outlet of the lake the river flows over a boulder dam which causes a rapid with a fall of three feet. This rapid may be run by light canoes. It is called Frenchmen's rapid from two French servants of the H. B. Co. having been drowned there. A portage on the east side may be crossed in three minutes with a pack.

Frenchmen's Rapid.

At the foot of the rapid is a good section of a sand plain. The top of the bank I found to be 85 feet above the river, and the average of the plain is several feet more. The high hills which had enclosed Whitefish lake now turned off to the east and west, and in front of them to the south stretched a sand plain. Through this the river had cut its way. At the rapid there is a poorly defined terrace about 26 feet above stream, which probably marks a stage in the development of the channel. On the east side the plain is not well marked, but it could be recognized from the west bank by the level line of trees. A low ridge, a few feet above the level of the plain, extends from the hills on the west as far as the rapid. The position suggests that it may have been a bar across the mouth of a bay when lake Superior stood at this height; but of this I am not certain. I had only a few minutes at lunch time to examine it, and did not go inland. The top of the bar is 90 feet above Whitefish lake, and so is 441 feet above Superior, Dog lake being 489 feet.

An extensive Sand Plain.

Three and a half miles below this rapid Cat portage is reached The river in the interv[al] is frequently very shallow, runni[ng] over gravel and small boulde[rs] At the head of the portage is a small boul[der] dam, but the real obstruction is a band gneiss which here crosses the river. T[he] fall I made to be 33 feet by aneroid. T[he] portage on the east side is level but sto[ny] It took eight minutes to cross with a pack –

Cat Portage.

Below the rapid, as well as above it, th[e] stream winds about in a gravel plain on wh[ich] there is plenty of spruce and tam[arac] rac. Currents from here to th[e] mouth were very frequent. Seven-eigh[ths] of a mile below the portage the Shequamk[a] comes in from the northeast. The stream i[s] about half the size of the Michipicoton a[t]

Shequamka River.

nt. Shequamka is the Indian for
in the River. At the mouth the
uns rapidly over well-rounded boul-
t is so shallow that a bark canoe will
oat.

ng my outfit I pushed up the stream
iles. Above the mouth the stream
deeper, but the current is too strong
le against and we were forced to pole.
ember half of the bed is out of water.
ulders which compose it are of all
nd mostly granitic. The banks are
10 feet high and composed of sand
vel; no clay was seen. Tamarac,
d spruce are the principal trees. My
formed me that lake Shequamka at
d of the stream could be reached by
om Missanabie by way of Dalton.

miles up the Shequamka a band of
an, less than a quarter of a mile wide,
the stream. The rocks, which are
nde schists, strike 110° and dip 80°
north. Gray gneiss striking 120° lies
these schists on the north.

miles below the mouth of Shequamka
he Michipicoton flows past a gravel
bank about 30 feet high. A mile
farther a small stream comes in
from the east, and a little beyond
another creek. On the east side
vel bank is here 50 feet high. Three
nd three-quarters below the She-
a third stream comes in from the
In size it is about one-third of the
mka. Louis told me that it came from
bout as large as Whitefish, probably
longer. The lake is known to the
as Aninchigaming. It is reached by
s of small lakes, the portage into the
which is a little above the mouth of
am. It would require one day to get
out.

arter of a mile below, granitoid gneiss
on the west bank. It contains con-
le plagioclase and very little biotite.
his stratified gravel and clay silt were
the bank. Two miles below is a hill
blende granite 299 feet high. The
overed with moss. Birch two feet in
er is common. Mountain maple is
nt, and a little hard maple. On the
nile below is gray gneiss.

Thunder hill, a striking cliff rising almost vertically from the river bed, is eight miles below the Shequamka. An aneroid reading made it 391 feet high. It is covered with trees, and no good outlook can be obtained except of a limited portion of the river. The hill is composed of Laurentian gneiss. Two miles below is a rapid which may be run with light canoes. The portage, which seems to be little used, is badly cut out and very rough. It is on the west side and takes six minutes to cross with a pack.

Thunder Hill

Just below the portage syenite gneiss occurs on the east. One mile and a quarter below, the Fine Sand river enters from the north, and three-quarters of a mile farther the High Falls of the Michipicoton are reached.

From the foot of the High Falls the river runs 12° north of west to lake Superior, which can be seen from the south bank a little inland from the fall. In a straight line the distance is eight miles, but the meandering of the river increases this considerably.

Camping at the portage I made two excursions, one of a day up the Fine Sand river, the other of two hours due south from the summit of the fall. The latter trip proved to be a very hilly one. Aneroid readings are however useless, as rain came on. One mile and a half to the south (an estimate) the gray gneiss of the river bank was replaced by Huronian conglomerate striking 115°.

The next morning I put one man at moving the camp to the lower end of the portage, while with the other I explored the Fine Sand river. We went north from a point about one-eighth of a mile above the mouth of the stream, crossing a hill of gneiss 383 feet high. It took an hour and 20 minutes to reach the first band of Huronian schist where it outcropped on the shore of a small expansion of the river. The distance inland I estimate to be little over a mile. The strike of the hornblende schist was 52°. The Huronian band proved to be quite narrow. Following the stream northward, gray gneiss was reached in 15 minutes. Just beyond the stream divided. We followed the western branch, which is the main stream. In 15 minutes the gneiss was succeeded by a hornblende schist

Fine Sand river.

striking about 80°. Huronian schists continue from here as far as I went to the northward, probably three miles and a half from the Michipicoton. About three miles inland the Fine Sand leaves a narrow lake. The lower end is about one-quarter of a mile long, two to four chains wide and bears 28° W. of N. The upper end, nearly a mile long and six to eight chains wide, bears 40° E. of N. The Huronian along the east shore strikes 40° to 60°. Returning I kept more to the east. Three-quarters of a mile south of the upper end of the lake a breccia of granite and greenstone was reached. The granite is clearly the later. A quarter of a mile farther the creek from the west was crossed. In another three-quarters of a mile undoubted gneiss was reached, which continued to the Michipicoton except for a narrow band of diabase one mile inland. We came out half a mile above the mouth of the Fine Sand.

High Falls of the Michipicoton.

The High Falls of the Michipicoton are a series of small falls in such quick succession that the whole descent of 80 or 90 feet is nearly vertical. In September the stream is small and half of the bed is exposed, but even then the sight is beautiful. A ledge of gneiss crosses the river and creates a barrier which is only very slowly being eroded away. Numerous pot holes were seen in the deserted part of the bed, but none of them were large.

A moraine has at one time dammed the river here to a greater height. On the north, where the portage crosses it, the summit of the ridge is 97 feet above the present river. On the south side it is not so high. This accounts for the stratified silts found in the banks of the river above the falls. They are simply sediments which were deposited in a narrow lake, since partially drained by the cutting down of the barrier at the outlet.

Long Portage at the Falls.

The portage on the north side is $1\frac{3}{4}$ miles long and takes 42 minutes to cross with a pack going down. The track is smooth and well-cut. The sand plain which it crosses shows several terraces. The first, 85 feet, is above the river at the foot of the portage, the second 113 feet, and the third 193 feet. The summit of the plain is 281 feet above. The total fall of the stream 184 feet. Below the Long portage the river winds about in a gravel plain for 10 miles with a swift current. What the fall from the foot of the portage to lake Superior is I failed to determine, as I traversed this distance after a rain, when my aneriod proved useless. The fall in the stream is probably about three feet per mile, which for 10 miles amounts to 30 feet. The beaches would thus be respectively 115, 143, 223, and 311 feet above Superior.

A claim was staked out on the portage. Messrs. Kimball and Connors showed me quartz from which they panned gold. It came from a mile south of the Michipicoton, a mile above the High Falls.

Geological features below the Falls.

At the foot of the portage the rock is an altered quartz porphyry striking 90°. The river here is so broad and shallow that I walked for some distance to lighten the canoe. Two miles below the strike of the schists is 130°. Glacial strie here run east and west, following the direction of the valley.

Below the portage there is less gravel than above, and it is finer. Considerable sand is seen, generally horizontal, occasionally cross-bedded. Between three and four miles below is a vertical bank 130 feet high. The sand is occasionally parted by layers of clayey silt half an inch thick. The top of the bank is a level plain covered with tamarac and blue-berries.

Diversion of the river channel.

About two miles up from the Post is a deserted channel of the Michipicoton. Sixteen or 17 years ago the river made a detour of over two miles to make an advance of as many chains. The Hudson's Bay factor cut a small ditch along an old portage trail across the neck of land (being less than 100 feet) and at the next season of flood the river took advantage of the cut and rapidly made a new channel. Coming down the stream and travelling north, at the present time an exact cross is met at this point. The arm to the east, the old channel, is blocked by a sand bar, but the unwary will keep straight ahead instead of turning off sharply to the west. Pursuing one's journey to the north a paddle of two miles or more will bring one back to the starting point.

from its mouth the Michipicoton
: waters of the Magpie and then
urns west into lake Superior, pass-
ng the Hudson's Bay Post on the
vay. About 200 yards above the
the Magpie, Wawa creek reaches
icoton from the northeast, leaping
level by a pretty fall of 10 or 12

›ton to Missinabie by Wawa.

› mouth of the Magpie river an
d runs in an almost straight line
Wawa lake, five miles to the
›rtheast. The road crosses a sand
ıe whole distance, and except for
it is an excellent one. For the
t of the distance it is perfectly
sides of some of the hills are
ıe old corduroy has not yet de-
ır. The plain is sparsely covered
'. Much of it has been burned
›ung spruce is growing thickly.
distinct terraces were noted in
e plain. The heights were de-
aneroid, in most cases more than
results are given in the following

perior	0 feet.
in.....	Undetermined.
›lain	84 feet.
.....	100 "
.....	110 "
ain.....	145 "
›lain	224 "
main plain	316 "
.....	350 "
ıke.....	328 "

beach is not crossed on the tote-
can be easily seen a little to the
›uth, where the Indian village
ands. The bank at the back has
›earance of river erosion. The
second plain, gently rising by a
of ridges. Along the front is a
of light sand, suggestive of an old
A short distance back a low ridge
a railway embankment runs east
The top of this ridge is 100 feet
iver. Back of this there is an-
less distinct and about 10 feet
the back of this plain and its
steep bank running N. 140° E.
This probably marks the summit of the Nipissing beach, which at Peninsula is 110 or 115 feet above Superior. Taylor (Am. Geol. xx p. 127) describes this beach as follows: "Its great length, compounded of many beach ridges forming beach plains, gives it a physiographical prominence that is not equalled by any other shore line of the lake region." The top of the bank is a plain 145 feet above the river. In a short distance another rise leads to the fourth plain, 224 feet above the river. A little north of the road a hill rises steeply from this plain. I found the top to be 512 feet above Superior. From the summit a good view was obtained of the valley of the Michipicoton and of the southern part of the bay. The third terrace could be traced for some distance in a line running 140°. The rocks were all Huronian schists striking 90°. The fifth terrace is about two miles inland. The fourth plain extends to the foot except where crossed by a creek. The bank has a declivity of about 45° and bears 110°. Lake Superior is visible from the top. From here the plain is very level until within a short distance of Wawa lake, where it rises 25 feet. The whole of this sand deposit is doubtless the result of melting ice. The terraces were probably formed in a rough way when the sand was laid down. Later the waters of lake Superior smoothed off the uneven places and cut the terraces more uniformly.

Wawa lake is a body of very clear water, extending about five miles to the northeast.

Wawa lake and Wawa city.

The original Indian name was Wawagonk, as it has been spelled on the published maps. Mr. Ross of Missanabie told me that it should be Wawungonk, that is the place of clear water. Whatever it once was, it is now the short Wawa. The lake is surrounded by high hills except at the southwest end, where the sand plain closes the valley. It receives almost no tributaries, so that the stream flowing out is quite small. Indeed with strong winds from the southwest the flow is stopped. Soundings at the lower end showed that away from shore the bottom was a level plain 93 feet below the surface. The height of the lake as determined by three fairly concordant aneroid readings is 328 feet above Superior.

farther it becomes 90°. Here it is underlaid by chlorite schist dipping 45° to the south.

The old Johnston locations

At the east end of Wawa lake are the locations numbered 3 to 6 and 9 to 14, taken up by John W. Johnston of Detroit about 1871-2-3. He was said to have done considerable development work and to have abandoned the properties as useless. I visited all the workings that could be pointed out by old employés, and they are certainly not extensive. On location 5 (?) two pits had been sunk, each five feet deep in quartz porphyry bearing 70°. A quartz vein 12 inches wide could be seen in the wall of one. Small pieces of quartz on the dump carried a little iron and copper pyrites. An assay of this quartz for gold yielded nothing. Louis, my guide, informed me that his father was one of Johnston's employés, and that he was engaged in packing out the ore in bags. Louis thinks that Johnston was looking for silver and copper, and other natives say the same. A considerable clearing was made on this location, as the stumps still testify. Small trenches were dug in the alluvial material in search of veins. No buildings were erected. A small wharf of logs and stone at the foot of a sandy bay marks the path to the old pits. In one of these I noticed a birch 15 feet high and three inches through. Another location near Michipicoton is described later.

Claims north and east of Wawa lake.

S. Barton has a claim 86 rods east of Wawa lake, on the portage. The country rock is a diabase carrying some pyrite. The vein is eight feet wide and dips 45° to the west. Over the hill to the north is claim 13, called the Little George by the discoverer, C. W. Bailey of Oscoda, Mich. The quartz is exposed on the wall of a cliff facing north. It is a wedge in shape, one foot wide at the top and 18 at the bottom. The country rock is a diabase carrying considerable pyrite. The quartz carries pyrite, chalcopyrite, pyrrhotite and malachite. A sample taken for assay yielded only a trace of gold. The foot of this hill is a talus of large angular blocks covered with moss. Walking is not only difficult but dangerous. A false step or a slip and one's leg is wedged in a crack between sharp rocks. In these crevices ice remains all summer.

Near the eastern boundary of Johnston's location 9, Albert Harvey of Wahnapitæ and Robert Holding of Chapleau found carbonaceous shales. The shales run about east and are exposed along the side of the hill for some distance. In places they are rich in pyrites, and this has weathered to a red ochre. Neither the coal nor the iron is of any value.

The tote-road running north from the east end of Wawa I followed for some distance.

On the tote-road to Grasett lake.

A few chains inland a small sand plain spreads out among the hills at a height of 72 feet above Wawa. Here are the ruins of quite a hamlet, a relic of the days of the construction of the Canadian Pacific. Where a creek crosses the plain some Californian prospectors had been searching for placer gold, but in vain. Passing through a narrow defile a triangular lake nearly two miles long is reached. It is 169 feet above Wawa. A hill of diabase at the east of the pass is 393 feet above Wawa.

The tote-road continues along the southwest shore of Eleanor lake and is so overgrown with willows that walking is very difficult. A narrow band of slates was crossed; then chlorite schists striking 95°. Some prospectors met in here had been unsuccessful in locating any veins. Where the tote-road crossed the sand plain good hay was growing on the cleared parts.

Across the narrow end of Wawa another tote-road began. This one lead to Manitowick, along the shores of a series of small lakes which have long served as a canoe route. The first portage follows the tote-road through a pass to the east as far as a small lake 105 feet above Wawa. The portage may be crossed in 10 minutes with a pack. To the east of the lake is a level sand plain which the tote-road crosses in a line running 58° after it has skirted round the first lake. The second portage follows the tote-road for about a mile and then turns off to the east.

Shortly before the turn the road crosses a small creek flowing south. Two weeks later Mr. Amey showed me at Michipicoton a small sample of native mercury which he claimed to have panned from this creek. It is exceedingly improbable that native mercury occurs

stream is running. It was from these that the placer gold of Mr. Amey is said to have come. As already explained, this is not the case. Indeed I do not think that any placer gold has yet been found in the district.

On the stream below the next lake a short portage of three chains is necessary for heavily loaded canoes. The fall is three feet. The cliff to the north is a gray biotite gneiss. At the foot of the portage is a beautiful lake which I have named Miller lake, after one of my travelling companions. The lake is three-fourths of a mile long and bears 60°. The outlet is to the north, in the second bay from the northeast end. As the upper part of the river is obstructed, a portage is made from the extreme northeast. This portage, known as Pine portage, is smooth and well cut. It may be crossed in seven minutes. A marshy bay 10 chains long leads to the river. The route might easily be missed in ascending the stream.

One-third of a mile below another lake is reached which has been named Blue lake, after my other travelling companion. The lake bears northeast and is about half a mile in its greatest length. To the north is a cliff of gray Laurentian gneiss about 250 feet high. Sand and fine gravel form the shore at the north. A bank 30 feet high is exposed where the river leaves the lake. After meandering for about one mile in this sand plain the river reaches Manitowick. This lake I make 40 feet below Hawk lake.

At the mouth of the Hawk river I met Mr. Paris and party, who had been prospecting for 11 days. They had been searching in granite and gneiss along the chain of lakes just described, and had found nothing at all. This is the usual experience of those who have prospected the gneissic country.

On the north side of the west end of Manitowick are bands of diabase six, 10 and 200 feet wide, enclosed in granite. About half way up the lake on the northwest shore the contact of the granite and schist occurs. The granite is the later. The schists strike about east, as do those on the opposite side of the lake. Near the contact the schists dip 45° to the north.

Northwest shore of Manitowick Lake.

On the north of the contact Allan and Nolan have staked some claims. No work had been done on them and I did not visit them. Mr. Allan states that he has two veins each three feet wide which can be traced for a mile. Samples which he showed me were heavily mineralized. One which I took contained about 10 per cent. of galena and yielded $2.67 in gold.

Farther to the northwest F. D. Grant has located two claims. One is on a bedded vein running 110° in hornblende schist. The other, which I did not see, is said to be four feet wide and to carry free gold.

One-half mile inland is a lake nearly a mile long and a quarter wide bearing east and west. On the south is a chlorite schist striking 100°. One mile inland is a felsite schist striking 110°. On the north of the lake is a quartz vein four feet wide.

The remainder of this trip through Manitowick and Dog lakes has been incorporated with the description of the trip from Missanabie to Michipicoton. By keeping men and supplies well in advance I was able to make this trip from Michipicoton to Missanabie in a little less than three days. Of this time two whole mornings were devoted to trips inland, and many other shorter stops were made. Sunday, September 26, was spent at Missanabie.

Missanabie to Magpie Lake

After purchasing supplies on Monday morning we started again for Michipicoton by way of the Magpie river. I was warned that I would have some difficulty in getting across to the head waters of this stream, and it proved to be the case. We coasted along the north shore of Dog lake and through the narrows leading into Loch Alsh. Both shores are Huronian. Glacial striæ north of Rabbit island bear 45°; the schists here strike 78°. At the narrows are a number of felsite dikes striking 153°.

Head waters of Michipicoton river.

The canoe route to Wabatongusheen is not up the Loch Alsh river as would be expected, but by portage from the extreme west end of Loch Alsh. It was at this point that the volunteers in 1885 left the train and were driven across a gap of 42 miles. The portage begins in a sandy bay and passes at once over the railway track and up a steep hill. It was crossed in 13 minutes with a heavy pack.

The rock on the portage is a chlorite schist striking 63°. A lake six chains wide was crossed, and then another portage six minutes long over a burnt hill brought us to a second lake. This lake, an L in shape, is 62 feet above Dog lake and about one-quarter of a mile each way. The stream flows in and out at the northeast corner. A narrow channel with little current connects with the third lake an eighth of a mile long. A third portage three chains long leaves this at the northeast angle. Wabatongusheen lake I made 10 feet higher, that is 72 feet above Dog lake. The lower end of the lake is in chlorite schist striking 108°. At the first narrows directly north of the outlet is a gneiss striking 128°. From here to Magpie lake almost the only rock was this gray gneiss. Wabatongusheen is surrounded by low hills well wooded with spruce and poplar, though burnt in a few places. The lake is named from the sandy narrows connecting the two parts. It is 14 miles long and is the source of the Michipicoton.

At the north of the lake we spent some time looking for an old trail leading to Pechonegoness lake. I went one mile west on low, swampy ground, but failed to find the lake where it was shown on the geological map. This having failed, I went north into Oba lake, expecting to cross from its southwest corner into the foot of Magpie lake. My Indian at first told me that this was feasible, but on reaching Oba he said he had tried a few weeks before and failed. As a result we had to go to a portage at the north end of Oba many miles out of our way. Between Wabatongusheen and Oba there are five portages. The first one is about a third of a mile in length. The trail is wet, stony and poorly cut out. It crosses the divide, which is not 10 feet above the lake, between the Superior and Hudson Bay slopes. A small pond at the north end is crossed and then a little creek followed to Oba. The second portage along the creek through a tamarac swamp is 10 chains long. Six chains down, the third one begins. It is about one-quarter of a mile long. The fourth portage is six chains and the fifth eight. The whole distance is about two miles. It took us three hours to cross, making two trips on the portages.

Crossing the divide to Hudson bay waters.

Oba lake is about 12 miles long, div a narrows into two equal parts. An reading gives it the same el as Wabatongusheen. On tl side it has been pretty thoroughly The rock surrounding is a gray gneis the south side a prominent dike of was noticed. Just south of the na creek enters from the west and we pus some distance, believing it led to th age. The creek is really dead water m ing in a grassy meadow. I afterwards that a portage could be made here, b the trail had not been used for years.

Oba lake to Magpie lake.

Above the narrows we discovered an hunter's lodge and gladly made in The old man, named Gebo, was not to point out the way but insisted o with us. On parting with him thre later I learned the reason. He was s with quinsy, and followed me hoping would give him medicine.

The canoe route follows a stream enters a grassy bay about two miles r the narrows. The creek winds abo burnt tamarac swamp for about five Near the end of the canoeable pa stream divides. The larger branch from the south. The northern or rig one is to be followed. In a few becomes overgrown with willows so t canoe is propelled with difficulty. Tl age begins at the foot of a well bur

For several miles around this po country had been burnt thoroughl Low rounded hills of gneiss were s every hand. In the hill at the portag were some small masses of mica Crystals of felspar three inches lor seen here.

The first portage is along the n side of the river for a quarter of a n is over well-burnt land, covered w and some boulders. Across the creek is here several canoe lengths in wi second portage begins. There is no trail. The course is northwest thr burnt swamp and over a hill. There fallen timber to be climbed and boul numerous. The creek we ascended off to the north and an arm from lake continued as a swamp nearly rea

ıe divide, again a continental one, cannot over 10 feet above Magpie lake. An eroid determination made Magpie lake 33 et above Oba, but this is certainly excesre. The barometer was rising all day. ive or 10 feet would be nearer the mark. his portage must be a mile and a half long. s roughness and length were very fatiguing. took six hours of hard work to get from ba to Magpie, the men making two trips on ıe portage. Near the Magpie end of the ortage a small mass of included Huronian hist was noticed.

Grasett to Michipicoton

Magpie lake is about 15 miles long and ıree wide in its broadest part. It consists of two parts almost equal in length, united by a narrow channel. Gray aurentian gneiss surrounds it on all sides. n a small island two miles from the north id and close to the west shore a mass of reenstone with porphyritic felspar occurs.

Magpie lake.

on an island towards the north. East of the narrows is a sand bank 30 feet high. From the southwestern end of the lake a canoe route of two miles leads to the railway track one mile east of Grasett station.

The Magpie river flows out at the southeast angle and crosses the railway at a point five miles east of Grasett. From the lake to the railway, a distance of two miles, the river falls perhaps three feet, and just below the bridge about eight more. The height of the river at the bridge, according to the C. P. R. profile, is 531 feet, and so Magpie lake is 534 feet above Superior.

Descent of Magpie River.

For the convenience of other travellers I give here in tabular form a brief description of the portages which we made on our trip down the Magpie. The number depends very largely on the amount of water in the river, and as this was low in September we lightened our canoes at several places not mentioned in the table. There are, in addition, very many strong currents which in coming up stream might necessitate portaging. Exclusive of the rapids the stream falls 219 feet in 60 miles, or over 3½ feet a mile, while theaggregate of the falls is 315 feet.

No. of portage.	Height of fall.	Portage on	Character of portage.	Approximate length.	Time to paddle between portages.
1	8 feet	east	good	8 chains	18 min.
2	2 "	"	"	2 "	31 "
3	5 "	"	stony	11 "	14 "
4	16 "	"	good	16 "	41 "
A pitch	2 "				52 "
5	Driftwood	east	good	5 chains	2 hrs.
6	15 feet	west	rough	11 "	5 min.
7	8 "	east	"	8 "	3 "
8	3 "	west		1 "	3 hrs 40 min.
9	10 "	"	good	10 "	2 " 10 "
10	2 "	"	"	1 "	1 " 30 "
11	60 "	east	steep hill	20 "	5 "
12	73 "	west	"	20 "	10 min.
13	113 "	"	good	30 "	

the north end of the lake the land, which the watershed between Hudson bay and :e Superior, is low and swampy. At the ıtre of the lake there are high bluffs on the st. A glacial stria bearing 8° was noted

The only method available for measuring the distance between the portages was the time consumed in paddling from one to another. In our case the rate of travel was three to four miles miles an hour, depending somewhat on the velocity of the stream. Calculating in this way, I make the distance from Magpie lake to Michipicoton Post a little over 60 miles, following the bends of the stream. In a straight line the distance is about 44 miles.

Details of the portages.

At the first portage the railway cuts through a moraine on the east bank of the river. The top of it I found to be about 78 feet above the track, and so 111 feet above the river. The boulders were mostly gneiss and granite, though fragments of Huronian schists were very frequent. Pebbles of limestone were also quite easily found. Some of these resemble the buff-colored Devonian limestone of lake Winnipeg, and have probably come from the palæozoic area south of James bay.

For some miles below the railway crossing the Magpie is a series of narrow lakes only a few chains wide, connected by short stretches of current flowing over gravel and boulders.

At the top of the fourth portage the river skirts a sand plain 40 feet above the water. The plain seems to be of small extent and low ridges of gneiss are seen outcropping.

The fifth portage is caused by a tangled mass of driftwood which has lodged in the stream. The portage is short and good, but the obstruction might be removed with little labor. Three miles below recent fires had entirely denuded the gray gneiss, which could be seen for some miles inland.

At 11 miles below Magpie lake there is a large mass of Huronian schist on the west bank. The real contact is however five miles farther down. About a mile below this apparent contact the sixth portage is reached. The seventh and eighth follow in quick succession. Nearly three miles below a long series of shallow rapids can be run in high water. Our guides paddled and waded down while we walked along the bank. The walking on the east bank is fair, but there is no regular portage.

Sixteen miles from the outlet of Magpie lake the contact of the Laurentian and Huronian is seen in a high hill on the east of the stream. The strike of the rocks is 88°, and both to the north and south of the ridge is an extensive gravel and sand plain. On the north side the plain is nearly 100 feet high and has been terraced by the river. On the south the plain is more extensive. From the hill a number of kettle holes could be seen, and four or five miles to the east a considerable lake was recognized by the vapor rising above it in the early morning. The hill is seen on the west also, but at a greater distance. A strong current is the only obstruction in the stream. According to aneroid readings at the rapids and estimates for the current this point is 98 feet below Magpie lake.

For five miles the river runs through a sand plain covered with jack pine, spruce and a little tamarac. In places the sand is underlaid with stratified clay, which is quite free of boulders. Eight miles below the contact a small creek comes in from the east. At the ninth portage, two miles lower down, the rock is a chlorite schist striking 128°.

Below the portage is a narrow lake three miles in length. On the west side a creek comes in about two miles from the north, and up this the old tote-road to Grasett runs. To the south of the mouth is a steep hill 275 feet high. The strike of the rock, which is diabase, is 98°. At the south end of the lake, 29 miles from Magpie lake, the tote-road crosses to the east bank, which it follows for three miles and then strikes inland to the upper end of Wawa lake.

At the tenth portage a few straggling ash trees were noticed. As lower elevations were reached they became more numerous. From this point the river is surrounded by high hills until it reaches the Michipicoton.

The eleventh portage is over a hill 160 feet high. The river falls 60 feet in three main chutes, with rapids between. The lower fall, visible from the foot of the portage, is about 20 feet high. The hill, which is of gravel, is very steep and the portage is poorly cut out. One mile and a half below the rock is a chlorite schist striking 58°. The boulders are here mostly greenstones and quartzite, with little granite. Small quartz lenses are frequently seen in the chlorite schist.

'een eight and nine miles below the h or Steep Hill portage a small stream from the east. A short distance below ke of the chlorite schist was observed 8°. From here down there is a notable e in the number of quartz pebbles in l of the stream.

)out 11 miles below Steep Hill portage of stratified sand and gravel 40 feet as observed. The lower 20 feet con-)f sand, then 10 of gravel and finally ind on top. Until the next portage ached seven or eight miles down, these ed gravels were seen at many points.) lower gravel flats there is quite a of black ash. About 13 miles below ortage, or seven from Michipicoton canoe route leads by trail and lake to stern end of Wawa lake.

uple of miles above the twelfth port- small band of conglomerate striking is observed. A short distance below nite was found. Apparently it is an e mass of this rock which causes the the twelfth or Contact portage a istance below. The river here falls in a succession of chutes and rapids. ge at the lower end is narrow and ous, and has been excavated along the of the granite and schist for some). Above the falls both banks of the are granite; below both are green- The portage on the west side is over hill of morainic material. Probably time this blocked the stream to a of 40 feet or more, and caused the on in the lake above of layers of silt and w found in the banks above the falls.

trike of the schists in the half mile the contact and the thirteenth port- about 165°. The last portage is down r a good trail for three-eighths of a a point opposite the Hudson s Bay The river falls about 113 feet in about ith of a mile. Numbering from the alls the heights are:

rst falls.....	26 ft.	
cond falls.....	39 "	
pids	10 " (?)	40 ft.
ird falls.....	25 " (?)	
pids	5 " (?)	
urth falls.....	8 "	
	113	

At the foot of the kettle below the second falls the stream in autumn is confined to a narrow channel in very hard rock. On October 8 we found it to be 10 feet wide and six feet deep, but flowing with great velocity.

Michipicoton and Vicinity

Michipicoton was reached for the second time on October 4. Accepting the kind invitation of the Director of the Bureau of Mines, I staid with him at the old Hudson's Bay Post. The men were paid off the next morning and sent back to Missanabie with the canoes. Two days were given to writing a preliminary report on the district, and then the time until the arrival of the steamer was spent in examining the vicinity.

Michipicoton Post is situated on the south side of the river, half a mile from its mouth. Michipicoton Post. It was one time quite a pretentious post, the buildings being large and numerous. All are deserted now except by a caretaker. Across the stream and east of the Magpie is the Indian village. The Indians, about 60 in number, are not on the reserve, which is on the north side of Michipicoton bay.

The river flows parallel to lake Superior for over a mile and about one mile inland. Between lies an irregular sand plain covered with spruce and other trees. Close to the shore it is entirely sand, but further in there is more loam.[6] At the Post excellent

[6] The plain on which the Post stands is thus described by Louis Agassiz, who visited the locality in 1848: "The lake shores present another series of interesting phenomena, especially near the mouth of larger rivers emptying into the lake over flats, where parallel walls of loose materials driven by the action of the lake against the mouth of the river have successively stopped its course and caused it to wind its way between the repeated accumulations of such obstacles. The lower course of Michipicoton river is for several miles dammed up in that way by concentric walls, across which the river has cut its bed, and winding between them has repeatedly changed its direction, breaking through the successive walls in different places. The largest and lowest of these walls, a kind of river terrace near the margin of the lake, shuts at present the factory from the immediate lake shore, and the river, which has cut its way between the rocks to the right and the walls, has left a bold bank in this dam on its left shore."—Lake Superior, p. 414.

potatoes were dug during my visit. Along the shore of lake Superior this sand beach extends for a mile and a half. Apparently it does not shelve out gradually, but dips suddenly. In the form of the beach and the character of the sands this resembles the terraces farther inland.

A small rocky island lies at the mouth of the Michipicoton. A few years ago the channel lay to the north of this islet, but now it is blocked by a sand bar and the river flows on the south. The channel is shallow however, and the waves break on the bar at its mouth.

The harbor for steamers is at Little Gros Cap, three miles west of the mouth. Boats of the fishing station have been transporting passengers and goods from Gros Cap to the Wawa landing. The old tote-road runs around the shore to the same point. The distance is somewhat longer, and the road is very rough. It is now overgrown with small brush, and the bridge across the Magpie is gone. The remains of the old camps of the teamsters can still be seen across the Michipicoton river from the Post.

Little Gros Cap harbor.

A little over a mile south of Michipicoton Post is a claim on which I found a quartz vein in granitoid gneiss. This area of gneiss is very small and is entirely surrounded by Huronian schists. The vein runs east and dips to the north. The quartz contains a little pyrite. A random sample contained $4.64 of gold. Nearly a mile farther southeast another sample of quartz was taken from a vein. This yielded $14.05 in gold. South of this is a small lake near the shore of which I took a sample of quartzose schist carrying 10 or 15 per cent. of pyrite. An assay gave $1.09 in gold. This lake is about a quarter of a mile long and the same wide. A very pretty creek leads to another lake below. Finally the stream emerges at lake Superior just where the sand beach ceases. The rock to the south is a talc schist.

Mining claims near the Post.

A mile up the Magpie is location B, taken up by J. W. Johnston about 1870-1. Guided by André, Mr. Blue and myself scrambled along the hill to the east of the Magpie to visit the old workings. It had been stated in the newspapers that thousands of dollars had been s Johnston, and we were anxious to see l where. André, a native of Michipicoto remembers the mining. He says fo were employed for five months. The of work performed bears out this sta We found a quartz vein in quartz p exposed along the face of a cliff. T runs 80° and is about eight feet wid top where enclosed in the wall roc country rock is itself well mineralize only work was an open cut at the bas cliff. This is now filled with quartz which have fallen or were blasted off t

Old workings near the Magpie.

At Little Gros Cap.

On Saturday afternoon we went t Gross Cap to be ready for the stea Sunday morning. The rocks in the of the wharf are agglomerates striki One piece of rock, which in place but did not seem t travelled far, was a schist con a well rounded boulder of granite. M and myself attempted to reach t hematite mine. It was blowing strong as we could not paddle around the p attempted to cross it. The neck of quite narrow, but the hills are very We spent nearly four hours travelling the cape, but failed to find the old wo The next morning we plainly saw th from the steamer. J. W. Johnston w interested in this property. Consi work was done in testing it, but no shipments were made. Mr. Macfarlan a report on the property which was pu in the Geological Survey Report of 18 it is almost inaccessible now, it is repr here:

Exploring Little Gros Cap.

"Gros Cap forms a small peninsula projects into the lake from the north of Michipicoton harbor. Th mine is situated nearly b quite at its southern extr The rock which forms this extremity to consist in places merely of pyroxe chlorite, and at others itgraduates into and diabase schist. To the north of t measures are to a great extent conceale vertical quartzite striking N. 63° W trudes, and a thickness of 150 feet

The Hematite mine on the Cape.

› be occupied by a quartz bed similar to
.e accompanying the ore. Succeeding,
obably underlying it to the northward,
bout 300 feet of greenstone slate con-
; in places both calcareous matter and
rites. This slate is underlaid by the
l, and where seen closest to the latter
es N. 25° W. The opening in the ore
about 10 feet wide, but this evidently
ot include the whole of the ore bearing
which here seems to occupy a valley
g northwestward between higher rocks.
ot wall of the opening, which consists
eat extent of ore, runs N. 37° W., and
3° southwestward. The excavation has
arried in on the strike of the bed for a
e of 120 feet, and with a depth of
20, at a level about ten feet above the
This is on the east shore of the pen-
, and at a very convenient place for
ng ore. The latter is a compact hema-
which is intercalated with bands of
ite. The thickness of the bands of ore
from one-half to four or five inches.
uartz bands are sometimes crossed by
cracks containing calcspar, and this
l is sometimes also present among the
hich occasionally assumes in cavities a
s structure and botryoidal forms. The
hickness of the ore-bearing bed is about
t, but the upper part is very poor, con-
g merely finely disseminated ore. An
nal band of pretty solid ore is found
six feet from the hanging wall of the
ut here the quartz forms much the
t body of the rock. Here the strike
0° to 30° W., dip 50° S. W. On following
pression which concides with this strike
e bed is seen to come out close to the
n the west side of the peninsula, but
he ore is very poor, consisting only of
inated varieties. Various openings
een made on the strike across to the
working, but they were filled with water
time of my visit. The ore was then
ncreasing in solidity at the main work-
nd if the same improvement should con-
a remunerative mine would soon be the
. This ore bed is underlaid by calcar-
reenstone slates, of which a thickness
eral hundred feet intervenes between
a third quartzose bed, which has also
been worked for iron ore at its outcrop near the lake, on the east side of Gros Cap. This ore bed seems to occupy a similar depression which strikes across to the west side, where a second quartzose bed containing ore is exposed. Here the rocks strike N. 30° W., and dip 45° S. W. At the point where this bed was worked, and from which some ore was shipped, the strike is N. 50° W., and the dip 48° S. W. The ore is of the same character as in the bed last described, but it is less rich. Underlying this bed, and continuing to the mainland, are found greenstone slates, varying in color from light to dark green, the strike of which is obscure owing to the prevalence of diagonal joints."[1]

Leaving Gros Cap on Sunday morning at 10 we reached Sault Ste Marie about two o'clock the next morning; and leaving there on the noon train we reached Toronto on Tuesday morning October 12, or 48 hours from Gros Cap.

Summary of the Geology.

Rocks of the Mining Division

The great majority of the rocks of the Mining Division belong to the Laurentian or Huronian systems. Of the former system the almost universal rock is a gray gneiss, finely grained and not particularly well stratified. At many places it becomes thoroughly granitic in structure, and then is often coarser-grained. While usually a dull gray in color, there are limited localities where a red felspar has given a brighter tone to the rock. The Huronian rocks are more varied in character. Massive diorites and diabases, and hornblende and chlorite schists are most common. Slates, felsites, quartzites and sericite schists are less common. Conglomerates occur at Little Gros Cap and northeast of Manitowick. Around Wawa lake there is a considerable area of quartz porphyry. The east, north and west sides of the Division are composed of Laurentian rocks; the Huronian system occupies the centre. The boundary between the two is at present very poorly defined. The accompanying map shows approximately the contact on the east. On the west and south almost nothing is known of it.

[1] Report Geol. Survey, Canada, 1863-6, pp. 130-1.

At the contact of the two systems it frequently appears that the Laurentian gneiss or granite has been erupted into the Huronian rock, and is therefore later in age. This is well shown on the west shore of the Dog lake, a little north of Little Stony portage. Fragments of the green schists are also frequently included in the gneiss, as can be seen at the southwest end of Hawk lake. The schists are nearly always vertical, and strike in various directions depending on their relation to the intrusive granites. These eruptive granites in many cases shade imperceptibly into true gneisses, as on Hawk lake. In this respect they resemble rocks of Lake of the Woods, which Lawson has mapped as Laurentian. Though later in consolidation than the Huronian fragments they enclose, these granites and gneisses are in the opinion of Lawson of earlier formation. In the map I have followed Lawson's views, and so have colored as Laurentian a number of points shown as eruptive granite on Bell's map.

Eruptive granites in the Huronian

No case was observed of a granite eruptive in gneiss, though doubtless examples will be found. Several small and isolated areas were found in the Huronian. Two miles south of Michipicoten Post is a small area of biotite granitoid gneiss enclosed in Huronian schists. Dikes of diorite and diabase are frequently found in the Laurentian gneiss, as on the lower end of Manitowick and on the south shore of Oba lake.

In the report of 1863-6 Macfarlane calls attention to a point on the shore 25 miles from Michipicoten harbor where rocks of four ages occur. Fragments of porphyritic hornblende schists enclosed in a coarse-grained syenitic granite were both cut by dikes of granite containing much less hornblende. These dikes were in turn intersected by another of finer grained granite containing only traces of mica or hornblende.

Lying above the Huronian on the north shore of Superior is the formation designated by Logan as the Upper Copper-Bearing Series, but now known as the Nipigon or Keweenawan. It consists of sheets of lava with intercalated masses of sandstone and conglomerate. The formation is extensively developed on Michipicoten island, which belongs geograph to the Mining Division but is not inclu it for administrative purposes. Withi Division only two small areas are known ist They were described by Logan as fo

Nipigon or Keweenawan rocks

"About two miles north of Cape Ch coarse grained bed, supporting some ness of sandstone colored red, with bands, and dipping a little to the so west at an angle of about 10 degrees, against a precipitous cliff of the older as if let down by a northeast and sout fault. About nine miles to the south of th peninsula of Cape Gargantua, and some small islands immediately near display gdaloidal trap, disposed in beds dipping south of west at an angle of about 40 de and resting unconformably on the gneis

Neither of these localities were vi but the traps at the latter cape were c visible from the deck of the small st on which we travelled. It is this form which on the south shore has proved s in native copper. Above the Nipigor mation the only deposits are those of pl cene and recent times.

This Division like other parts of nor Ontario has been strongly marked by g action. To the north, near height of land, the hills are fo most part low and rounded, almost no talus can be found at the The boulders everywhere are at least what rounded. Towards lake Superio hills are much higher and a talus of an blocks is frequently found. The valle the streams are filled with glacial debris. Michipicoten from Whitefish lake t mouth winds about in gravel and sand p The Magpie for most of its course flows gravel and boulders. In their lower co these streams have cut deeply into sand plains. At one point on the Mi coton I measured a bank 132 feet high. sand plain damming Wawa lake is 11 above the bottom of the lake. These and gravel plains occur very freque Many of them are of considerable size. extending from Wawa to Michipicoten i miles long. East of Wawa is another miles long. At Pigeon portage, nort Hawk lake, and south of the contact of

Evidences of glacial action

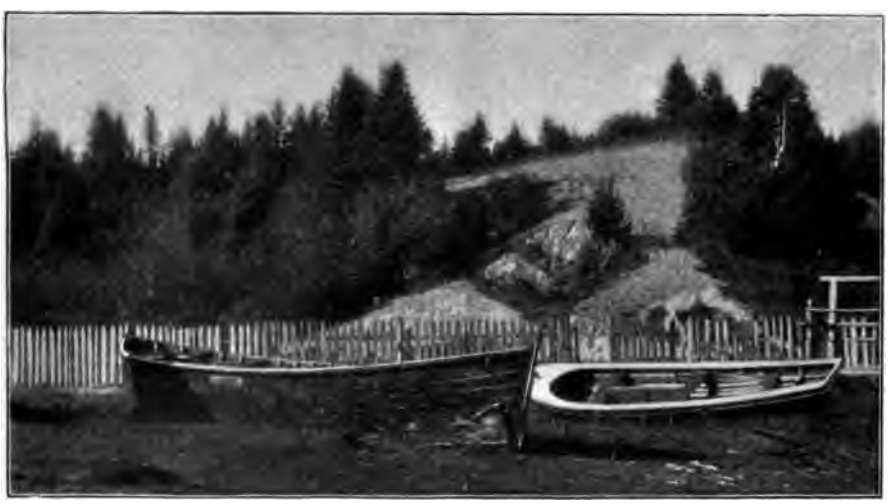
River Terraces at mouth of Toad River, east shore of Lake Superior. From Agassiz's 'Lake Superior.

Lake Terraces. Locality not specified, but apparently on north shore of Lake Superior, about three miles below the Petits Ecrits. From Agassiz's 'Lake Superior.'

Michipicoten Post in 1848. From Agassiz's 'Lake Superior.'

Michipicoten Post in 1897. Indian village and low mountain ranges in the background.'
Photograph by Miller.

Michipicoton Post in 1897. Buildings on west side of the quadrangle. Photograph by Miller.



Sand dune west of Michipicoton Post. York boat and Clipper skiff in the foreground. Photograph by Willmott.

Indian Mission Church at Michipicoton, showing terrace in background. Photograph by Miller.

Indian burial ground at Michipicoton Post, north side of River. Photograph by Miller.

Indian Village at Michipicoton. Showing River and Lake terraces. Photograph by Willmott.

Missanabie, on the Canadian Pacific Railway. Photograph by Miller.

Magpie are other extensive plains. Kettle holes also are frequent in these plains. Examples occur on the tote-road leading east from Wawa lake.

Geologically the district very strongly resembles that of Lake of the Woods. Physical aspects of the district. Physically however the country is different. High hills and steep cliffs are here the rule, while in Lake of the Woods low rounded hills immersed in water prevail. A more striking difference has resulted from the glacial action in the two districts. In Lake of the Woods most of the superficial material has been swept off to the south; here the valleys are filled with glacial débris.

Along the height of land near the Canadian Pacific Railway the country becomes more level; there are more muskegs and less gravel and sand deposits. Lakes are more numerous, with rocky ridges between, and the resemblance to the Lake of the Woods country is striking.

The divide of the waters flowing into Hudson bay and into lake Superior is in no place high. While it is generally supposed that a lofty range of hills is to be found, the reverse is true. Between Oba and Wabatongusheen lakes the summit of the swamp is not more than 10 feet above the lakes on either side. Between Magpie and Oba lakes the lowest land is perhaps 10 feet above water level. The same is true between the head waters of Missanabie river and Dog lake.

Mineral Resources.

The metal most likely to be found in large amounts in this district is gold, although discoveries of nickel, iron and copper have also been reported. Gold, Nickel, Copper. Almost nothing is yet known definitely as to the occurrence of any of these. Gold has been found at a number of places in visible particles, and in all cases simply chipped from the surface. At no place in the Division had a pit been sunk to a depth of over 10 feet at the time of my visit. Assays alone are available for the formation of an opinion. These are at best somewhat uncertain, and in this case it is much more so. No property so far as I know has yet been systematically sampled. The reports of assays given me by prospectors were frequently made on samples showing free gold, and so are almost worthless. Eleven properties from which I took one sample each yielded an average of $8.17. Of these eight yielded less than $4. On the other hand there are properties assays of which have yielded over $100.

Quartz veins occur in large numbers and of great size in parts of the Division. Around Wawa lake this is particularly the case. Gold-bearing quartz veins. The enclosing rock is here a quartz porphyry for the most part. The veins generally run with the strike of the rock, but some cut across it. Frequently the veins form the precipitous sides of cliffs In this case they are easily traced, and often for a considerable distance. On the whole the quartz is white, and does not usually carry any large amount of sulphides. Iron and copper pyrites are the chief accessory minerals, though galena and pyrrhotite are occasionally found.

A comparatively small area has yet been explored, and this with no great thoroughness. Little over two months prospecting has been possible since the announcement of the gold discoveries. What little exploration has been done has been almost entirely confined to the vicinity of lake Wawa and the canoe route north to Missanabie.

So far the best finds have been made on the shores of Wawa and Manitowick lakes. Similar country rocks are however widely spread, and equally good deposits are quite as likely to be discovered in the future. In western Ontario the vicinity of the contact of the Laurentian and Huronian has proved to be the richest in gold. It is quite probable that the same is true of this region.

As to placer gold, the early reports have proved false. I panned in the beds of a number of streams, but did not get a color. Prospectors whom I met reported the same. The present streams are but reassorting glacial drift, and it is not probable that gold will be found in their beds.

As to other minerals, little can be said. Native copper occurs in considerable amounts on Michipicoton island. Copper and other minerals. At Cape Gargantua a small area of the same Keweenawan formation holds a little native copper. A location was taken

up here years ago by the Montreal Mining Company, but little work was done. Small seams of chalcopyrite are said to occur in the green slates on the east of Michipicoton bay. On the north side of the bay and upon the Doré river is a location formerly examined by the Upper Canada Mining Company. The massive Huronian rock "is traversed by numerous quartz veins holding yellow copper ore, and more rarely the vitreous species." Some locations northwest of Hawk lake were taken up a few years ago for nickel. A small amount of development was done, and work stopped because of lack of funds, I believe.

The only iron deposit known is that on Little Gros Cap already described. North of Wawa lake a boulder of jasper and hematite, resembling the Minnesota rock was found.

Other Resources.

The only other industries at present carried on in the district are hunting and fishing.

Fishing and Hunting.

Along the east shore of lake Superior a series of fishing stations has been established by a Sault Ste. Marie firm, and large quantities of white fish and trout are shipped to Chicago and other markets. In the smaller streams excellent speckled trout are found.

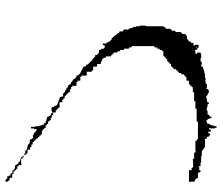
Hunting is carried on by the Indians, but south of the height of land it is no longer very remunerative. The Hudson's Bay Company has closed its posts at both Michipicoton and Pic, but the one at Missanabie is still maintained.

Timber and Soil.

The timber resources are not great. Perhaps one-half of the country is burnt over, principally to the north. Of the remainder, poplar and birch cover one-half, and spruce, jack pine, tamarac and balsam cover the rest of it. There is some cedar in the valleys, and to the southeast hard maple is found. The spruce is often 18 inches in diameter, and is of value both as mine timber and for pulp. At Bachewahnung bay, 8 Michipicoton, a large is cut yearly and shipp N.Y. Near the railway for ties. There are onl red or white pine. The areas of level country, gravel and covered to a with sand charged with plains lie among the hi south. They are of t composition as the gra Ontario. At Michipi have been cultivated wi long time. Other gar flourish. The country is adapted for raising h tote-roads red clover growing thriftily. Th climate ensures a certa As streams abound on probably prove an excel

Water powers.

Water powers are of In a distance of 48 mi falls 489 feet, course of abou 534 feet. The numerou waters of both stream flow somewhat even t The Magpie where it Michipicoton one mile the latter descends 113 10 or 15 chains. The th 26, 39 and 25 feet resp half a mile above thi chutes in which the r about 20 chains. Ten r the Michipicoton falls 1 two miles. Towards th falls are usually not s Superior, but are q Details of these are give report, and some of the marked on the map.



Economic Geology of Eastern Ontario

Corundum and other Minerals

By Willet G. Miller

Introduction

THIS preliminary Report on the Economic Geology of Eastern Ontario deals more particularly with the occurrence of corundum in the counties of Hastings, Renfrew and Peterborough, but a few notes are also given on other minerals.

In October, 1896, Mr. W. F. Ferrier, lithologist of the Geological Survey of Canada, reported the occurrence of corundum in the township of Carlow, Hastings county.[1] This was the first occurrence of the mineral of any economic importance known to exist in Canada.

Considerable interest being taken in this discovery of the mineral by manufacturers of emery wheels and others, it seemed advisable that a careful examination be made of the deposit in order to learn something of its economic value. Moreover it was thought that a determination of the character of the deposit would be of assistance in the search for other occurrences of the mineral in the district.

The writer was accordingly instructed by the Director of the Ontario Bureau of Mines to undertake an examination of the corundum-bearing rocks and to search for other deposits of the mineral in the district. In addition to this he was instructed to make careful notes on deposits of any other minerals of economic importance which might be met with in the field.

The work was begun in the latter part of the month of June, 1897. A short account of the field work done up to the end of August was given in the Sixth Report of the Bureau.

[1] Summary Report Geological Survey of Canada, 1896, p. 5, and Sixth Report Bureau of Mines, Ontario, pp. 61-63.

On the way to the corundum locality a few days were spent in an examination of certain mineral deposits along the line of the Irondale, Bancroft and Ottawa Railway, more particular attention being paid to deposits of iron ore similar in character to some of those in the more eastern part of the Province on which the writer had previously done some work. These ores will be again referred to in this report.

In the early part of July a few days were spent in company with Mr. N. T. Armstrong in the township of Carlow, in an inspection of the occurrence of corundum reported by Mr. Ferrier and in an examination of two other occurrences of the mineral known to Mr. Armstrong.

On the 5th of July I left the field for Kingston, having to take charge of some classes in connection with the summer session of the School of Mining. On the 2nd of August I left Kingston for the field again and arrived at Combermere in the township of Radcliffe the following day. From this date till the 15th of October, with the exception of a few days which were spent at the meeting of the British Association for the Advancement of Science in Toronto, I was engaged in field work.

After having determined the mode of occurrence of the corundum, most of my time was spent in prospecting for the mineral in the northern part of the county of Hastings and the southern part of the adjoining county of Renfrew.

Outcrops of corundum-bearing rocks were found at different points across country in these counties for a distance of 30 miles, and in seven different townships.

On my way home from the field in October I made a hurried examination of a belt of rocks, similar in character to that in which corundum occurs, in some townships lying immediately to the south and west of those to which reference has just been made. After this I spent a couple of days in the township of Methuen, in Peterborough county, where corundum also occurs.

During most of the time I was in the field I was assisted by Messrs. R. T. Hodgson and W. C. Rogers, students of the Kingston School of Mining. I am much indebted to these gentlemen for the enthusiasm they showed in the work.

In November I returned to the district in order to get out some of the corundum-bearing rock for a mill test. Several tons of it were taken out and shipped to Kingston, where the test has been made under the superintendence of my colleague, Prof. Courtenay De Kalb, an account of whose experiments accompanies this Report. I am indebted to Mr. Wm. Mason, lecturer on Surveying, for the maps and sketches which accompany this report ; and also to Dr. W. L. Goodwin, under whose direction a number of analyses of corundum have been made.

My assistants and myself, during the progress of the field work, received many favors at the hands of persons living in the district, which I desire to heartily acknowledge.

Geology of the District

Time did not permit of a careful examination of the geology of the district outside the strip of country in which corundum-bearing rocks were found. Such an examination would moreover be superfluous, as the geology of the region in which the district is situated is being worked out by officers of the Geological Survey of Canada. Dr. F. D. Adams and Mr. A. E. Barlow are in charge of the work in the western part of the district, and Dr. R. W. Ells is making a study of the eastern part. An outline of the results of these gentlemen's work in the region has been given.[2] The work which they have thus far done is of a very important nature, and throws much light on the characters and relations of the Laurentian rocks. They appear to have proved that the term Hastings series is no longer needed, the rocks to which this name was applied by the earlier workers in the field being of the same age as those of the Grenville series. Thus an end seems to have been put to the puzzling Hastings series which has heretofore been of doubtful age

Work carried on by members of the Geological Survey.

[2] Annual Report, Geol. Surv. Can, vol. vi. (N.S.), Part J.
Am. Jour. Sci., July, '94.
Summary Reports, Geol. Surv. Can., 1895-6-7.

and position, whether Laurentian or Huronian. This taken in connection with the work previously done by Dr. Adams in determining the true character of the so-called Norian or Upper Laurentian makes our knowledge of this most ancient group of rocks much more definite. It has also been found that there is not the sharp division between the Grenville series and that of the Fundamental gneiss that one would expect to find in the field after reading descriptions in older works on the subject.

Archæan Rocks

The work of the officers of the Survey during the last few years seems to have proved that we have rocks of roughly three ages, in the Laurentian, viz.: (1) a lower group of igneous origin, the Fundamental gneiss; (2) a group, the Grenville series, of somewhat varied mineralogical character, consisting chiefly of metamorphosed sedimentary rocks, overlying the Fundamental gneiss; and (3) a group of rocks of igneous origin which have been more or less metamorphosed and which cut through the members of groups 1 and 2. It may be added that Dr. Adams and Mr. Barlow find evidence that the rocks of the Grenville series have to some extent sagged down into the underlying Fundamental gneiss at some period of their history through the latter group of rocks having been more or less fused or rendered plastic by the great pressure and heat to which they were subjected. The same relation is seen between what are known as the Laurentian gneisses and the members of the Huronian series in northwestern Ontario, a fact which was first pointed out by Dr. A. C. Lawson in a report which Sir Archibald Geikie in his great Text Book of Geology speaks of as a "remarkable essay."

Groups of the Archæan rocks.

We may hope that within a few years the workers in Archæan geology of the staff of the Geological Survey, having cleared up the history of the Laurentian, will explain to us more clearly than has yet been done the relation which this system of rocks bears to that which has been called the Huronian. It may be that then they will show that the term Huronian is no more required than Hastings, and it is possible that it will be found that what we now call Laurentian and Huronian are composed roughly of three great groups, the lowest of igneous origin, on which lies a group composed chiefly of metamorphosed sedimentary material, both being cut through by igneous rocks. Recent work has certainly simplified the theories concerning the origin of the different members of the Laurentian, and it is hoped that investigation in the near future by these same Canadian workers will still further simplify our knowledge of the whole Archæan.

Palæozoic Rocks

In eastern Ontario rocks of later age than the Laurentian are found overlying them unconformably. These rocks are of Cambrian, Silurian, Glacial and Post-glacial age. Patches or outliers of Cambrian and Silurian strata are found widely scattered over the Laurentian, leading to the belief that at one time the rocks of the Laurentian were completely covered by Palæozoic sediments, but that these latter have since been to a large extent removed by agencies of denudation. In the adjacent part of the Province of Quebec the distribution of the Palæozoic strata over the Laurentian is similar to that of Ontario, and moreover the Palæozoic strata in this latter Province are sometimes cut through by igneous rocks. It will be seen, then, that there is a similar relation between the Palæozoic strata with the dikes which cut through them to the whole Laurentian, if not to the whole Archæan, that there is between the members of the Laurentian. In the case of the latter system of rocks we may consider it as before stated, to be made up of three divisions, a lower group, or what has been called the Fundamental gneiss, overlain by a group largely of sedimentary origin, forming what may be considered outliers over the underlying gneiss, and an uppermost group, the youngest of the three, composed of more or less metamorphosed igneous rocks which cut through the members of the other two groups. The Fundamental gneiss forms the floor on which the other members of the Laurentian have been laid down (or have cut through), just as

Post-Archæan rocks of eastern Ontario.

the Laurentian as a whole forms the floor for the Palæozoic strata, which are also cut through at times by igneous rocks.

Relations of Archæan and Palæozoic.

A parallel may be drawn between the history of the earth during Laurentian and Palæozoic times in eastern Ontario and human history. During the Laurentian period after the solid crust had been formed sedimentary material was laid down,—limestones, sand and gravel deposits,—and eruptions of igneous material took place. The Laurentian period lasted for a great length of time, and after the rocks had been folded, altered and changed and gone through a process of decay as it were, subterranean agencies having ceased their activity, another set of rocks, the Palæozoic and later, were laid down. Similarly in human history, civilization in remote ages appears to have reached a high state and then gone into decay, and upon its ruins has been gradually built up the modern state of society.

Corundum-Bearing Rocks

The band of rocks of Laurentian age in the northern part of the county of Hastings and the southern part of the county of Renfrew, in which corundum has been found, may be said to be made up of three important kinds, gneiss, syenite and quartz pegmatite.

What appears to be the oldest rock in the belt is dark colored and more or less gneissoid in structure. It is in all probability a metamorphosed igneous rock and might now be called gabbro-gneiss. In megascopic character it is pretty uniform throughout the belt. The dark colored minerals which predominate in it are hornblende and biotite, of which the former is in greater quantity. The other generally most abundant constituent is plagioclase felspar, but in some cases the felspar, or the more basic varieties of it, is decomposed. The percentage of silica in the rock agrees with the view that it is an altered gabbro or gabbro-diorite. Several examinations were made of specimens from different parts of the belt and these range in percentage of silica from about 47 to 53. This gneiss, the oldest rock in the belt, is cut through by a series of dikes or masses, which consist largely of felspar or felspathoid minerals in which occurs the corundum. In some cases these dikes are light pink in color, while in other cases they are gray or white, depending on the color of the felspar, but the pink colored rock is less abundant than the other. These dikes are interesting in several respects.

Gabbro-gneiss.

Syenite and Nepheline Syenite.

Syenite and Nepheline Syenite dikes.

Along the greater part of the strike of the dikes the rock has sometimes the character of coarse syenite, but in some cases it passes into nepheline syenite. In both varieties of rock corundum is found at times. Nepheline, a mineral which plays the part of a felspar in rocks, is a comparatively rare substance in many parts of the world. Some nepheline holding rocks when weathered have much the appearance of crystalline limestone, and are apt to be mistaken for this rock. It is not surprising then that some of the thrifty German settlers of South Renfrew in their desire to obtain lime for building purposes should have collected pieces of nepheline syenite and heated them in kilns. The writer saw two or three kilns where attempts to burn this rock into lime had been made. One farmer told him that they had heated the rock in the kiln, with true German persistence, for five or six days, and that if Sunday had not then come on they would have continued "firing up" in their endeavors to reduce the rock, which they so firmly believed to be limestone. One interesting result has been produced by this heating of the rock, as in some boulders the nepheline has been fused while the felspar remained comparatively unaffected and was left as a skeleton of the rock. Some pieces of the rock of considerable size which have not been subjected to a high enough heat to fuse the nepheline have taken on a blue or greenish color over the greater part of their surface, causing them to resemble the sodalite which occasionally accompanies the nepheline. In this connection it may be stated that another mistake concerning the nature of nepheline was made at one of the mica mines in the township of Methuen, which will be referred to later in describing the occurrence of corundum there. At this mine the nepheline occurs in coarse, massive form in narrow

dikes. It was mistaken by the owner for a very pure and valuable variety of felspar, and he proposed to ship it to Detroit and use it in the manufacture of porcelain. It would be interesting to know what would have been the result of this experiment, whether as interesting results, to the mineralogist at least, would have been obtained from this attempt to make the mineral nepheline serve some useful purpose as were obtained in the attempt to burn it into lime. Cases such as these show the need there is for the dissemination of at least a little accurate knowledge concerning minerals and the methods of determining them among the inhabitants of our mineral districts, which indeed occupy much the greater part of the Province. A little knowledge concerning the hardness of minerals alone would often save much loss of time and expenditure of money, to say nothing of the evil effects resulting from the raising of false hopes. During last summer the writer was shown over half a score of different minerals and rocks which the possessors believed were corundum. If they had known anything of the hardness of minerals they could easily have found out their mistakes for themselves.

As has been already stated, the most abundant constitutent in the group of igneous rocks in which corundum occurs is felspar, but this is replaced to a greater or less extent in some cases by the felspathoid mineral, nepheline. The other important constituents of this group of rocks, outside of corundum, are black mica, hornblende, which is sometimes represented by its very basic variety, hastingsite, and white mica. Quartz has never been observed by the writer in any hand specimen of rock taken from these dikes or masses.[3] These dike rocks, if we leave out of consideration the occurrence of corundum in them, which of course lowers their acidity, may be described as syenites. Three or four varieties may be made of these. In some cases the rock is composed largely of felspar; at other times it contains mica or hornblende, and could then be called a mica or hornblende syenite; while, where the nepheline comes in, we have nepheline syenite. Magnetite is quite abundant at times. Pyrite is present in rare cases, and there is considerable variety of secondary minerals more or less micaceous in character, which have not as yet been worked out. Where the syenite occurs in association with garnetiferous rocks, as in the northeastern part of Raglan, it carries garnet. Crystals of zircon, some of which had a diameter of one-eighth of an inch, were found in the syenite at one locality in Dungannon. Sodalite is sometimes present in the nepheline syenite. As the syenite on analysis appears to contain only a trace of magnesia the poorness of the rock in spinel, which so frequently accompanies corundum in other districts, is accounted for.

Various forms of Syenite.

In general it may be said that the corundum occurrs more abundantly in the ordinary syenite than in the nepheline syenite, but the crystals of corundum are usually much better formed in the latter than in the former. The corundum-bearing dikes vary much in width, which is usually some feet. In one case the writer observed a clear and well defined dike on the side of a hill in the thirteenth concession of the township of Carlow, whose width was only 1¼ inch and which had corundum studded pretty thickly through it. Other well defined dikes had a width of five or six inches.

Occurrence of corundum in Syenite dikes.

There are many dikes similar in character to those in which corundum occurs which do not contain this mineral. It may be present in one part of a dike and absent in another. It is frequently seen to have segregated in lines or patches through the rock, causing the rock to be richer in some parts than in others.

Both the nepheline syenite and what has here been called the ordinary syenite often occur in broad dikes or masses, and it would be possible for one not making a careful study of the district to conclude that these two rocks belonged to different periods of eruption, or possibly came from different magmas.

[3] As however the corundum-bearing dikes are frequently cut by quartziferous pegmatite, hand specimens may be obtained from the contact which show the two minerals, quartz and corundum, closely associated. The two kinds of dikes, quartziferous and corundum-bearing, frequently resemble each other rather closely in coarseness of grain and in color.

Sometimes the one rock passes somewhat sharply into the other in the same dike or mass. In this case if the line of passage is obscured one would be apt to conclude that the rocks belonged to different periods of eruption. But we have an "ear-mark" as it were in the occurrence of corundum in both kinds of rocks which at once attracts attention and causes one to look further into the relations existing between them. Having found that the nepheline syenite passed into ordinary syenite, and vice versa, in some cases following along the strike, the writer made use of this knowledge in prospecting for corundum. If a mass of nepheline syenite containing no corundum were found the dike or mass in which it occurred would be followed up with successful results in some cases, the corundum coming in when the nepheline became less abundant or absent. In the case of one broad dike or mass in the township of Lyndoch, coarse nepheline syenite was found outcropping at the road side. After following the dike for about a mile, until nepheline was no longer observed on the weathered surface of the rock, corundum was found. In the case of other dikes search was rewarded with success in the same way.

A key to prospecting for corundum

Granite and Syenite.

In somewhat close association with the syenite dikes of the corundum belt in parts of the district is a light colored granite. This rock in the field and in hand specimens resembles somewhat closely the finer grained varieties of the syenites. Indeed it was often only after careful megascopic examination that the two rocks could be distinguished, quartz of course being present in the granite and never, so far as the writer has observed, in hand specimens, in the syenite. The lighter colored syenite and the granite both frequently have an ash-like appearance on weathered surfaces. As corundum has not been observed in the granite, it is important for the prospector to distinguish this rock from the syenite, which closely resembles it.

Avoiding the granite.

The relation which the granite bears to the associated syenite was not determined satisfactorily, chiefly on account of lack of time. The writer's work in the district was mainly of a prospecting nature, and had for its object the examination and discovery of deposits of corundum. As this mineral was found in a number of new localities in the district, and as one "find" led on to another, there was little inclination to turn off from the main object of the work to examine the character or relations of rocks in which the mineral sought for was not to be found. Whenever therefore the granite referred to was met with, some other direction was taken and an outcrop of syenite was sought for. It would not be surprising however if it were found on future work that the granite and the two varieties of syenite were of one period of eruption. There is probably not much greater difference between the acidity of the syenite high in felspar and the granite than there is between the acidity of the former and the syenite, which sometimes contains a very high percentage of nepheline. We have in the case of the granite however no mark by which we can connect it with the syenites such as we have in corundum in the syenites, although in general appearance, as before stated, it resembles some varieties of them closely.

Pegmatite Dikes and Limestone.

In addition to the syenite dikes and masses, which cut the dark colored gneiss, there is another set of dikes whose relation to both of these rocks is easily made out. These dikes are quartz pegmatites, or coarse granites, and are younger than the corundum-bearing dikes, which is shown by the fact that these latter dikes are often cut by them. The quartz pegmatites are usually light pink in color and resemble in general appearance some of the coarser pink varieties of the corundum-bearing dikes. These coarser varieties of the latter dikes may also be spoken of as pegmatites. The quartz-bearing dikes contain as essential constituents in addition to quartz, felspar, which is usually the most abundant mineral present, and hornblende, which is usually pretty badly decomposed. Magnetite is a frequent accessory mineral in these pegmatites. Two or three trap dikes were observed which appear to be of late

Quartz pegmatite dikes.

origin than the corundum-bearing dikes, and probably also than the quartziferous dikes.

Areas of crystalline limestone.

Crystalline limestone, generally in small areas, was found in different parts of the district, but in no case was this rock seen to be cut by the corundum-bearing rocks. These areas of crystalline limestone may be considered as outliers over the Fundamental gneiss, and were no doubt at one time connected and formed areas of considerable extent, but have been disconnected by denudation.

Boulders of Silurian rocks were met with in the northeastern corner of Raglan, and in part of the corundum-bearing area of Lyndoch and Sebastopol. These likely came from outliers which are known to exist a few miles to the north. Two or three kilns were seen in which Silurian limestone boulders were made use of for the production of lime.

Modes of Occurrence

As original and secondary constituents of rocks.

Corundum has been found occurring under different conditions in crystalline rocks. In some cases it is an original constituent of the rocks, *i.e.*, it was formed at approximately the same time as the mass of the rocks in which it occurs. In other cases the mineral is of secondary origin, having crystallized out in the rocks at a later date than most of the material with which it is associated. Corundum occurs as an original constituent in different igneous rocks. In eastern Ontario it occurs, as has been stated, in syenite. In other countries it occurs in granite, basalt, andesite, tra hyte and other igneous rocks.

The occurence of corundum in the Ilmen mountains referred to in a recent paper[4] by Dr. Persifor Frazer, is particularly interesting in connection with the occurrence of the mineral in eastern Ontario. Dr. Frazer says: "The Ilmen mountains which lie close to the town of Miass are celebrated as the depository of many both intrinsically and scientifically valuable minerals, some of which are peculiar to the range. Thus, miaskite, (nephelinic or elæolitic syenite with biotite), named by Gustav Rose, is not peculiar to these mountains only, which bear the name of Ilmen, but also to their prolongations and the mountains Baiksky, Sobatchia, Potanina and Wichniowaia. In this continuation another characteristic rock is found composed of anorthite and corundum. In the gneiss of the Ilmens and their northerly prolongations veins of a rock composed essentially of corundum and orthose are found. M. Karpinsky considers this an analogue of the syenites, the corundum taking the place of biotite." In Ontario also facies of the corundum-bearing syenite consist essentially of corundum and acidic felspar, the former mineral sometimes predominating.

Corundum is found as a secondary constituent in various metamorphic rocks, having been produced in them through the agencies of alteration to which they have been subjected. In eastern Ontario and other parts of the world *e.g.*, Burma, etc., it is found in crystalline limestone. Some of the best gem varieties of the mineral have been found in this rock.

Rocks of all kinds carrying corundum are broken down through the action of the atmosphere and other agencies into gravel and sand, and hence the mineral is often found in loose deposits in the beds of streams and elsewhere. In these water deposits it is found associated with other minerals of high specific gravity, such as native gold and magnetite.

Some of the foreign localities where the mineral occurs in economic quantities are those of North Carolina and Georgia, (corundum), Chester, Mass, (emery), and Montana, (gem varieties). A great part of the emery of commerce comes from Turkey and the Grecian Archipelago. Gem varieties are obtained from Burma and other parts of the world.

Corundum in Burgess and Methuen.

Reference to the mineral in the Geology of Canada.

Up to the time of Mr. Ferrier's report of the occurrence of corundum in the township of Carlow, in October, 1896, the only known occurrences of the mineral in Canada are those referred to in the Geology of Canada, 1863. At page 499 it is stated that

[4] Geological Section from Moscow to Siberia and Return, Ac. Nat. Sci. Phila., Oct., 1897, p. 436.

"Corundum has been observed on the second lot of the ninth range of Burgess, and in the immediate vicinity of a deposit of copper pyrites. Here, in contact with the crystalline limestone, occurs a rock made up of felspar, quartz, calcite, silvery white mica and sphene. Disseminated through this aggregate were small grains of a mineral whose color varied from light rose-red to sapphire blue, while its hardness, which was greater than that of topaz, showed the mineral to be corundum. Small crystals of light-blue corundum have been found elsewhere in the limestone of the vicinity." Reference is also made in the same volume (p. 519), to the occasional occurrence of the mineral in the auriferous sands of the region on the south side of the St. Lawrence river, in Quebec. "Where, by the process of washing, the heavier portions of the auriferous gravel have been brought together, they are found to contain abundance of black ferruginous ores, consisting of magnetic iron, hematite, both specular and compact, chromic iron and ilmenite, with occasional grains of garnet, rutile and more rarely zircon and corundum."

Rediscovery of the Burgess deposit.

As no specimens of corundum from the North Burgess locality were in the possession of the Geological Survey, and as no person now living was known to have seen the mineral in place, or even a specimen of it, the writer decided to visit the locality and try to obtain specimens. Accordingly, in November last, after the completion of the field work in Hastings and Renfrew, a trip was made to North Burgess in company with a party of students in connection with the field classes of the Kingston School of Mining. The mineral was found to occur under the conditions described in the Geology of Canada. Lot 2 in the ninth concession of the township of North Burgess is now the farm of Mr. Rathwell. The specimens were found in white crystalline limestone near the edge of a field, alongside of the lane and 200 yards or so from the farm barns. A specimen of the mineral was also found in a piece of rock which had been thrown out from a shaft which was sunk years ago in search for copper. The shaft is situated in the lane, and lies between the place where the other specimens were obtained and the barns. The specimens obtained were all of small size, and were of a light rose-red color. A number of small openings have been made in the crystalline limestone in the immediate vicinity of the shaft to which reference has been made, the rock being used for burning into lime. The specimens were tested and were found to scratch topaz.[5] It may be stated that a few fine specimens of eozoon canadense were also obtained here.

Corundum in Methuen.

After the discovery of corundum in Carlow had been made public, the mineral was also reported to occur in the township of Methuen, Peterborough county, where it had been found some time before, but had not been identified. The writer visited this locality in October, and the mineral was found to occur in rocks similar to those in which it occurs in Hastings and Renfrew. A dark gneiss similar in appearance in hand specimens to the rock referred to in Hastings and Renfrew is cut by dikes and masses composed of syenite and nepheline syenite.

Qualities of Corundum

The quality of hardness.

The mineral corundum is one of the hardest natural substances known, being excelled in hardness only by the diamond. Its position in the scale of hardness arranged by Mohs, is between that of the topaz and diamond. Mohs made use of the numbers from 1 to 10 inclusive in his scale, and selected 10 characteristic minerals of different degrees of hardness in making up the scale, which is as follows: 1, talc; 2, rock salt; 3, calcite; 4, fluorspar; 5, apatite; 6, orthoclase; 7, quartz; 8, topaz; 9, corundum; 10, diamond.

[5] As however the mineral spinel has a hardness equal to that of topaz, and occurs in limestone under conditions similar to corundum, it would seem advisable that a careful examination, chemical and otherwise, be made of these specimens before their character is affirmed. As the specimens are of small size and are obtainable only near the surface of the ground it is somewhat difficult to determine them. One specimen obtained had a somewhat suspicious octahedral appearance. A specimen, which appeared to be somewhat impure, was found to contain 74.5 per cent. of alumina.

In determining the degree of hardness which a mineral possesses we try it to see if it will scratch or cut a mineral whose hardness is known, or we may determine whether a mineral of known hardness will scratch the specimen under examination.

As corundum is often more or less altered or changed into secondary minerals, mica, etc., care should be taken in selecting a specimen of this mineral for a test of its hardness to make use only of a specimen which shows no sign of alteration, and which appears to be free from impurities. As corundum is also somewhat brittle, care should be taken not to be deceived by the breaking of the mineral. A crystal of quartz with smooth surfaces is useful in distinguishing other hard minerals. As most minerals which have a hardness greater than that of quartz are comparatively rare, one has generally little difficulty by its use in determining whether a given specimen is corundum or not. A crystal of topaz is still more useful, and small crystals of this mineral can be obtained from mineral dealers at small cost. The prospector for corundum should also possess some typical specimens of the mineral for the purpose of comparing hardness and other characteristics.

Composition and Form.

Corundum is composed of the oxide of aluminium (Al_2O_3) but traces of the oxides of other metals are generally present as coloring materials. As in the cases of other minerals of non-metallic lustre, the color of corundum varies considerably. Sometimes the mineral is colorless or white, and at other times it is found possessing a blue, pink or red, brown, gray or other color.

Composition and color.

The relative weight of corundum compared with equal volumes of many other minerals is high. It has a specific gravity of about 4, i. e., it is four times as heavy as an equal volume of water, while felspar has a specific gravity of from 2.4 to 2.7 and quartz of 2.5 to 2.8. Its weight in hand specimens thus aids in its determination.

Specific gravity.

Corundum crystallizes in what is known to mineralogists as the rhombohedral division of the hexagonal system. Well developed crystals are often somewhat long and narrow, tapering towards a point at either end.[6] A cross section of a crystal is six sided. When the crystals are well developed they possess a number of planes at either end. Crystals of the mineral however from different localities differ considerably in form.[7]

Crystallization.

The crystals of this mineral generally possess a well defined parting, or show a tendency to split readily in certain directions. On some of these parting surfaces two sets of very fine lines are generally distinguishable, dividing the surface into small four sided areas.[8]

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[6] The first discovery of corundum in the Hastings district is said to have been made by a small child over 20 years ago. She and her father were sitting on the rocks resting after a walk through the woods, and the child picked up a crystal of the mineral which had weathered out of its matrix and asked her father if it did not have a shape like the glass stopper of a cruet stand bottle. Those who have seen these corks, and most people have, will have no difficulty in picturing to themselves the form commonly assumed by corundum. Although attention was directed to the mineral at this time, and also a few years later when it was mistaken for apatite, it was not identified till 1896.

[7] Mr. George F. Kunz in referring to the corundum (sapphire) crystals of Montana (Mineral Resources of the United States, 1896-7, p. 1201) says that "Their form and occurrence, moreover, agree with the important experiments and conclusions of Lagorio, viz, that corundums originating in an igneous rock form flat hexagonal tables with low rhombohedra." It cannot be said that the flat hexagonal tables are characteristic of the crystals from Hastings and Renfrew counties. The crystals from these counties, in the nepheline syenite especially, are often much elongated—sometimes having a length of 4 or 5 inches and a diameter of less than half an inch. The characteristic forms assumed by the mineral in these counties are shown in some of the reproductions from photographs which accompany this report. The forms assumed by corundum in igneous rocks would seem to depend on the acidity of the magmas from which they crystallized, and probably on other conditions as well.

[8] Prof. Nicol has given me the following note on the Hastings and Renfrew crystals:

"The crystals of corundum occur imbedded in the felspathic matrix. They are slightly altered to mica on the surface, and hence may often be readily separated from the felspar by carefully breaking away the latter with a small hammer.

Corundum is infusible before the blowpipe, but is slowly dissolved in borax and phosphor salt. It is not acted upon by acids. If finely pulverized the mineral takes on a blue color after heating with cobalt solution.

Other qualities.

Varieties of Corundum.

There are three subdivisions of the species, to which the name corundum is given, recognized in the arts. These are: (1) Sapphire, which embraces the purer kinds of fine colors, transparent or translucent, which are useful as gems. These gem stones are given different names according to the colors as sapphire (blue), and ruby (red). (2) Corundum, which includes the non-transparent kinds of dark or dull colors. (3) Emery, which is a granular corundum, black or grayish black in color, and more or less intimately mixed with magnetite or hæmatite. Some varieties of corundum are among the most costly and highly prized gem stones.

Subdivisions of Corundum.

Corundum has been produced artificially in various ways, different compounds of aluminium being used for the purpose. In most cases these compounds are subjected to the action of other substances at a high temperature. It has been formed by the decomposition of aluminium chloride through the action of magnesium and water vapour in a closed tube; by the decomposition of potash alum by means of charcoal, and in other ways. Many other minerals and even rocks have been produced artificially in the laboratory, but in most cases the results obtained have been of little economic importance. An interesting artificial production of corundum, considered in connection with the occurrence of the mineral in eastern Ontario, in nepheline syenite, is that in which the mineral has been produced by dissolving alumina in melted nepheline and allowing the molten mass to crystallize.

Artificial production of Corundum.

Uses of Corundum

In commerce corundum and its varieties are divided into two classes, viz.: gem stones and abrasive materials. The gem stone varieties have already been referred to. They are of comparatively rare occurrence, and when of high quality they are of great value.

Gem stones.

By the term "abrasive material" is understood a substance which is used for grinding or polishing purposes. Corundum proper and emery are used for this purpose.[9] The powdered substance is made

Abrasive material.

The material was secured by blasting from the face of a cliff and after the explosion the ground in the vicinity was strewn with crystals, separated from the matrix by the force of the concussion. The crystals are rough and often exhibit rounded or 'barrel-shaped' forms due to the presence of numerous pyramidal faces, but as the faces are neither smooth enough for measurement with the reflecting goniometer, nor large enough for measurement with the contact goniometer, it is difficult to determine them.

"Horizontal striæ are very prominently shown on the crystals. The basal plane, sometimes small, sometimes almost the full size of the prism, occurs very commonly. Parting parallel to this basal plane and also to the planes of the rhombohedron, is common. Striæ due to polysynthetic twinning are very clearly shown on the parting faces. These striæ are often shown on the basal parting plane also.

"The color and lustre of the crystals viewed on the basal plane are often very similar to those of hypersthene or bronzite. Some of the crystals show what Tschermak calls "isomorphous layering," fig. 1, (taken from Tschermak's Mineralogie). On one crystal the peculiar appearance shown in fig. 2 was presented. On the basal plane of a fairly well defined prismatic crystal rests a triangular plate. This is evidently a section of a rhombohedron, parallel to the basal plane, properly oriented on the basal plane of the prism."

[9] Other materials used as abrasives are carborundum, crushed steel, diatomaceous earth, garnet, grindstones, millstones, pumice, quartz crystal, tripoli and whetstones. The production of the artificial substance carborundum, which is the chief competitor of corundum and emery, increased from 595 short tons ($365,612) in 1896 to 621 short tons ($153,812) in 1897. The decrease in value was due to a heavy reduction in price by the sole concern, the Niagara Falls Co., producing this substance. "The Engineering and Mining Journal" of New York from which these figures are taken further states that the production of corundum, in the United States, declined from 250 short tons ($35,000) in 1896 to 230 short tons ($32,200) in 1897. Emery is said to have declined from 1,550 short tons ($108,500) to 1,500 ($105,000) during the same period.

into "emery" wheels, the grains being cemented together by some suitable substance. The use of emery wheels in grinding down steel or other instruments is well known. Some of these wheels are moistened with water when being used, but others have to be used in the dry state, their cement not holding together after being wet. Emery is also used in the form of grains and powder.

Corundum has been used in the production of aluminium, but as it is in such demand as an abrasive material it is too costly to be used as an ore of this metal.[10] If its price were lower there would no doubt be a demand for it as an ore, on account of its generally being pretty pure and possessing such a high percentage of the metal.[11]

Ore of Aluminium.

The uses of aluminium are being constantly extended. Many interesting results have been obtained with it in connection with alloys, one of which is of particular interest in Ontario. It is stated that of the alloys so far examined the one which seems to give the best present results and the greatest promise is that with nickel. The addition of a few per cent. only of nickel to aluminium greatly enhances the strength and toughness of the metal, and adds to its brilliancy without adding materially to its weight.

Uses and metallurgy of aluminium.

The metallurgy of aluminium offers a very inviting field for research. Alumina in a suitable form for the extraction of the metal is said to sell at about 4½ cents per pound, or two tons of alumina, which represent about one ton of the metal, are worth about $180. As aluminium sells at $700 per ton there would seem to be a considerable chance for the discovery of methods of extraction whereby the metal could be produced more cheaply. Moreover it does not seem altogether unlikely that methods of extraction will be discovered whereby a less pure alumina than that demanded by manufacturers at present can be used for the production of the metal.

[10] The Mineral Industry, vol. i, p. 11 and 163.

[11] The production of the metal aluminium in the United States in 1897 was 4,000,000 lb. ($1,400,000) against 1,300,000 lb. ($520,000) in the previous year. The increase was due partly to reduction in price for the metal and partly to the development of a greatly increased export trade. The United States and Europe together produced 5,516,000 lb. in 1896. In 1891 the United States produced only 150,000 lb. of the metal.

The year 1897 was distinguished by the beginning of an export trade in the United States of the mineral bauxite, which is the ore of aluminium used at present. In this year 2,537 tons of the mineral were shipped abroad.

Corundum contains theoretically 53.2 per cent. of aluminium and is usually pretty pure. Bauxite contains theoretically 40 per cent. of the metal but there is frequently from 30 to 50 per cent. impurities present.

History and Statistics of Corundum.

Different varieties of corundum were known to the ancients, who made use of it as a gem and as an abrasive material. The emery of the Grecian islands has long been known. It is thought by some that the native races of America, judging from certain carvings on rocks, have made use of the mineral.

Early uses of the mineral.

In the Geology of Canada, 1863, reference is made as has been already stated, to the occurrence of the mineral in the township of North Burgess, and to its occurrence with other minerals in the auriferous sands of the Chaudiere. No other occurrence of the mineral in Canada was made public until the report of its occurrence in the township of Carlow in October, 1896. This may be accounted for by the fact that most people are attracted only by minerals of a metallic lustre, and so pass over those of a "stony" nature. If a part of the energy expended by prospectors in this Province in search for the precious metal had been employed in hunting for other substances, it seems not unlikely that many more valuable and interesting minerals would have been found.

Lack of interest in prospecting for it.

It is difficult to get reliable statistics on the production and consumption of corundum. In the Mineral Resources of the United States, 1895 and 1896, a Government publication, it is stated that "The producers of both emery and corundum are averse to giving publicity to their business, and in order to maintain the confidential nature of the statistics the production of the two minerals is stated together." Manufacturers of emery wheels

Statistics of production and consumption.

in Canada claim there is a "combine" among the producers of the raw material to keep up the price, and they seem desirous that other deposits be opened up so that the price of the material which they make use of in their manufactures will be lowered.

The present selling price of North Carolina corundum quoted in the Engineering and Mining Journal of New York is from $140 to $200 a ton, being at the rate of 7 to 10 cents per pound. Emery is quoted at 1½ to 5½ cents per pound.

The corundum and emery produced in the United States in 1895 is stated to have been 2,102 short tons, valued at $106,256, and in 1896 the production was 2,120 short tons valued at $113,246. "The corundum used in the United States is exclusively of domestic production. Emery is imported from Turkey and the island of Naxos, one of the Cyclades group in the Grecian archipelago."[12]

The imports of emery in 1895 were valued at $133,038, and in 1896 they had a value of $148,231. The imports of emery into Canada for the last ten years have averaged about $15,000 annually.

Location of Ontario Deposits

North Burgess in Lanark county.

The corundum of the township of North Burgess, while interesting from the mineralogical point of view, is, as far examined, of no commercial importance. It occurs on lots 2 in the ninth concession, about three miles from the town of Perth and a few miles north of the Rideau canal.[13]

Methuen in Peterborough county.

The mineral in the township of Methuen, Peterborough county, occurs at the Bennett and Miller mines, where the syenite dikes containing it have been worked for mica, one of the important constituents of the rock. These deposits are situated on either side of a small lake near a hill which is known in the vicinity as the "mountain." These occurrences of the mineral are in the ninth and tenth concessions of the township. The locality can be reached in summer by taking the Grand Trunk or Canadian Pacific railway to the town of Peterborough, thence by railroad to Lakefield on Stony lake, from which a boat can be taken to within four or five miles of the deposits. From the landing place there is a road to the properties referred to. Or the C. P. R. may be taken to Havelock or Norwood station, and the corundum locality may be reached by a drive of about 20 miles across country northward. A stage runs from the last mentioned railroad station to within a short distance of Stony lake.

In Hastings and Renfrew counties.

The corundum deposits of the northern part of the county of Hastings and the southern part of the adjoining county of Renfrew are of easy access. A train on the Ottawa, Arnprior and Parry Sound railroad may be taken to Barry's Bay station, from which place a small steam boat runs in summer to the village of Combermere on the Madawaska river. This village is situated within three or four miles of part of the belt or band of rocks in which corundum has been found. The location of these villages is shown on the map. The localities in which the mineral has been found in Hastings and Renfrew may be reached also from the south either via the Irondale, Bancroft and Ottawa railroad to the vicinity or the village of Bird's Creek, from which

[12] Min. Res., U. S., 1896, p. 12.

[13] It may be explained for the benefit of the foreign reader that the older settled parts of the Dominion of Canada are divided into a number of Provinces or primary divisions. The Province of Ontario, the most populous of these, is again subdivided in the older settled parts into counties. These counties are subdivided into townships and these again into concessions, or, as they are sometimes called, ranges. Concessions consist of narrow strips of country running from one side of a township to the other, separated by public road allowances or highways, and to each concession a particular number is given. These are subdivided into lots, which are given consecutive numbers from one end of a concession to another. The counties of Ontario vary considerably in size, as do also the townships. The lots referred to in this report and shown on the accompanying map consist of about 100 acres each, but in some parts of the Province they are of larger size. Such expressions as "lot 10, concession XVI. of the township of Raglan" will be understood after reference has been made to the map. The writer has been asked once or twice to explain the meaning of local geographical terms met with in scientific papers and reports on Canada and has decided that it might be well to do so here.

place a stage runs twice a week to New Carlow post office in the township of Carlow, or via the Central Ontario railroad to Ormsby station and thence by a drive across country. Horses and rigs are to be had for hire in any of the villages mentioned. A number of interesting mineral deposits are situated within easy access of stations on the railroads just mentioned, which could be visited by any one having a little time at his disposal during a trip into the corundum district. To one interested in minerals and geology generally the district offers great attractions. Coming in from the north the train could be left at Eganville station if desired and some of the famous mineral localities of the township of Sebastopol, noted for its twin zircons and other specimens, could be visited. The eastern end of the band of corundum-bearing rocks, so far as traced out, lies in the southern part of this township, the writer having found the mineral in place here during the past summer.[14]

Water Power, Labor and Supplies.

Water powers on the Madawaska and its tributaries.

As will be seen by the larger map, the York Branch joins the Madawaska river in the northern part of the township of Raglan, in the vicinity of some of the corundum deposits. Near the point of junction of these is what is known as Palmer's rapids, which is capable of supplying an immense amount of water power. At points on the York Branch, marked as rapids on the map, there are also good water powers; there is also a water power at New Carlow post office on Papineau creek in the township of Carlow. This power is now made use of in running a grist mill and saw mill. In this, as in most parts of the Laurentian country, water powers are numerous. Even if not situated within easy access of a mineral property, they could be made use of in generating electricity for transmission to long distances.

[14] The location of the railroads and places to which reference has been made is shown on the small index map at the head of this paper. The distance of some of the railroad stations, in the corundum district, from some of the chief cities of Ontario is also shown on the map.

Labor, supplies and timber.

Most of the men living in the district are well fitted for mining work, having been employed in lumbering operations and in railway construction. There is thus no lack of experienced teamsters, and of men used to blasting operations and to the construction of rough wooden and stone structures. Although the district is not thickly settled, still it can furnish sufficient agricultural produce for the support of a mining population of considerable size. Moreover, freight charges on any supplies that would be required to be imported into the district would be low on account of the railway connection. Sufficient timber for mining purposes can be obtained near at hand, and there is an unlimited supply of wood for fuel.

Extent and Method of Exploration.

Exploration of the territory.

At the time of my first visit to the district in the early part of July corundum had been reported to occur only in the townships of Carlow and Raglan. Mr. N. T. Armstrong showed me over the lots on which the mineral had been found in Carlow. These were lot 14 in the fourteenth concession and lots 15 and 16 in the sixteenth concession. Early in August, on my return to the district Mr. Henry Robillard showed me over the lots in Raglan on which the mineral had been found. These were lots 1, 2, 3 and 4 in the nineteenth concession and lots 3 and 4 in the eighteenth. No other occurrence of the mineral in the Province had been made public except the one in the township of North Burgess, described in the Geology of Canada, and that in the township of Methuen, 40 miles distant to the southwest of Carlow. The occurrences in these two townships have already been referred to in this report. All other deposits to which reference is here made, which occur in a band of rocks stretching across country for 30 miles in parts of seven different townships, were discovered by the writer and his assistants between the first week in August and the first week in October.

On beginning systematic work on the corundum deposits in the early part of the month of August a few days were first spent in a a study of the known deposits and their

associated rocks. As the district is a very hilly one, and as the rocks are covered to a considerable extent by brush and soil, it was at first feared that considerable difficulty would be experienced in making out the relations of the rocks, and therefore that the discovery of new deposits of the mineral would depend largely on chance. However, after examining the known deposits in the townships of Carlow and Raglan, it was found that the mineral occurred under the same conditions in both, and after determining the strike of the rocks in both localities it was concluded that the deposits all belonged to one band of rocks.

Studying the known deposits and associated rocks.

It was first decided to examine the rocks lying between the two localities in which corundum had been found. On making this examination outcrops of rock carrying the mineral were found at numerous points between lot 14 in the fourteenth concession of Carlow and the lots in Raglan which have been referred to. The deposit of corundum on this lot in Carlow lies at the lower part of a face of one of the highest hills in the district. The hill forms part of a range of high hills which run from this lot in a northeast direction through Carlow into Raglan, and is continued across the York Branch river in this township. In Carlow the hill spreads out towards the south to the north of the twelfth concession, about one mile north of Foster's lake. These high hills are situated in the thirteenth, fourteenth, fifteenth and sixteenth concessions of Carlow and have a trend northeast from lot 14 in the fourteenth concession, facing in a general way northwest and southeast. The position of the hills can be made out in a general way from the roads on the map. The winter road running from the main road near lot 14 in the fourteenth concession and thence across Grady lake, lots 15 and 16 in the fifteenth concession, to the junction of the main road near the point where the corners of the townships of Carlow, Bangor and Raglan join, follows a valley lying at the base of the hills. Similarly the main road running from the point where it is joined by the winter road in the thirteenth concession of Carlow to near the point where it is again joined by this road near the northeast corner of Carlow follows the low land lying at the foot of the hills to the southeast, although in some places the road runs at some distance from the hills. The Rag'an deposits referred to are situated on the southern or southeastern face of a high hill, the low land at its base stretching out to the marsh or drowned lands along the York Branch. It is difficult to give a detailed description of the topography of the district, high hills being very numerous and being generally not connected into ranges. It may be said however that the highest hills in the strip of country through which corundum has been found form a range whose direction is in a general way paral'el with that of the town line or boundary between the townships of Raglan and Radcliffe. This fact was at first of some assistance to us in prospecting, as after we had succeeded in finding corundum at points along the hills between the previously known deposits of Carlow and Raglan we decided that the hills of similar height in line with these between the York Branch and Madawaska rivers were likely to be of the same nature, the strike of the rocks moreover being in the same general direction as the line of hills.

Deposits in Carlow and Raglan.

Topography of the country.

The strike of the rocks near the northeast corner of Raglan changes somewhat, and the height of the hills also becomes less from here to near the south end of lake Clear in Sebastopol, where the hills again become high. The term high is here used only in a comparative sense, the hills in this district being much higher than those commonly met with in eastern Ontario, but not nearly of so great an altitude as those of some other parts of the Province.

Extending the Field of Discovery.

Having succeeded in connecting the previously known deposits in Carlow with those in Raglan by means of others lying between them, and thus having traced the corundum-bearing band to near the western edge of the York Branch, which here occupies a wide channel between the hills, it was decided to search for the mineral on the lots lying between this river and the Madawaska. This search was soon rewarded with success, the

Tracing the corundum belt to Madawaska river.

mineral being found on lot 9 in the seventeenth concession, not far from Gottlieb Lenz's farm buildings. Shortly after this the mineral was found on lot 19 in the eighteenth concession. This lot occupies a part of the highest hill near the junction of the two rivers. Subsequently the mineral was found on lot 13 in the seventeenth concession, and in small quantities on two or three other lots.

The surface of the ground is pretty well covered with soil, small timber and brush on most of these lots. Hence there is generally difficulty in determining the extent of the deposits. The hills are rather flat on top and most of the settlers' clearings are situated on them.

From the deposit situated on the hill on lot 19 in the eighteenth concession the village of Combermere can be seen up the Madawaska river. The mineral occurs in the rock near the summit of the hill and on its northeast slope. The corundum rock is cut by dikes of pegmatite carrying pink felspar, hornblende and quartz. Corundum shows in the rocks at places along the face of the hill for 30 yards or so, with a width exposed in places of 10 yards. The rock shows to some extent a schistose structure. The corundum rock is seen to have weathered more rapidly than the dikes which cut it, leaving them standing above its surface. Small patches of the corundum-bearing rock carry over 30 per cent. of the mineral.

On lot 13 in the seventeenth concession in the vicinity of the corundum over 90 per cent. of the surface is covered with soil, making it difficult to estimate the amount of corundum present. A number of outcrops of the rock carrying corundum were however seen, the mineral occurring in both pink and white felspar rock. On this lot as well as on lot 19 in the eighteenth concession it seems likely that considerable of the mineral would be brought to view if a little work were done removing the surface covering of soil.

Mineral in drift-covered rocks.

East of the Madawaska.

At the time of my departure for Toronto on August 17 to attend the meeting of the British Association for the Advancement of Science, I gave instructions to my assistants to search for the mineral immediately to the northeast of the Madawaska river, as the corundum-bearing rocks had now been proved to extend from the township of Carlow into Raglan and had been found across the wide valley of the York Branch. While in Toronto I was notified by my assistants that they had succeeded in their search for the mineral on the opposite side of the Madawaska to that on which we had been working. They discovered the mineral on lots 24, 25, 26, 27 and 28 on or near the line between the eighteenth and nineteenth concessions of Raglan, and later in the season we found it on lot 35 in the eighteenth concession of this township. On lots 24 to 28 there is considerable rock carrying the mineral.

Continuation of the belt eastward.

Near the line between lots 24 and 25, and near the boundary between the eighteenth and nineteenth concessions, the corundum-bearing rock has a distinctly laminated or schistose structure. At this particular point corundum was found in the rock for a distance of 100 yards diagonally across the strike and over a width of about 50 yards. The mineral is however more abundant in some parts of the rock than in others. This outcrop of the rock is a few hundred yards from a small rapid on the Madawaska river which lies a short distance below the foot of Palmer's rapids. A trap dike which has a width of about 12 feet is in close proximity to the corundum rock. Some of the corundum on lot 26 of the nineteenth concession is very coarse grained.

Radcliffe and Brudenell.

The strike of the rocks, as has been already stated, changes, bending more towards the northwest along the boundary between Radcliffe and Brudenell. In the latter township, which joins the northeast corner of Raglan, corundum was found on lot 34 in the fifth concession, lot 34 in the seventh concession and lot 24 in the sixth. The mineral was also found on lot 31 in the second concession of the adjoining township of Radcliffe. It will be seen from the map that these lots lie north of the line along which the mineral occurs in Raglan and Carlow, the situation of

Change in the strike of rock towards Radcliffe and Brudenell.

the deposits agreeing with the change in direction of the strike. The strike on lot 34 in the seventh concession is northwest. The place on this lot where the outcrop of the corundum-bearing rocks occurs is near the side of the German road and about 1½ miles from the village of Rockingham. The deposit is near the house of R. Adams. The rock possesses a foliated structure, and corundum is scattered through it for a distance of over 250 yards along the road. A considerable part of the rock is nepheline syenite, and in places the mineral occurs in considerable quantity. There is at times a noticeable percentage of magnetite associated with the corundum, some specimens of the two associated having a rather striking appearance, nearly white corundum being surrounded by the black magnetite. This mixture of the two minerals may be said to form a coarse grained emery.

On lot 34 in the fifth concession the outcrop of the corundum-bearing rock is situated near the top of a hill in a cleared field close to the farm house of Mrs. Frederick Block. In this deposit the mineral for the most part is coarse in grain and part of the rock holds a high percentage of it. The richest part of the rock has a width of about 8½ feet and a length of 26 feet, but the exposure is covered by soil on its sides and ends, under which it strikes. The part of the rock richest in corundum, judging from hand specimens, contains no nepheline, but nepheline syenite outcrops between the deposit just referred to and the house. From the point where the rock is richest in corundum to the house is a distance of about 125 yards. The nepheline syenite carries sodalite and the usual accessory minerals, as well as corundum.

Crystalline character of corundum in nepheline syenite.

It may be stated that the corundum which occurs in nepheline syenite on this lot and at other places in the district often possesses a pretty perfect crystal outline, differing in this way from the mineral which occurs in rock in which nepheline is absent. In the latter case the mineral usually possesses a very imperfect crystal outline. The crystals in the nepheline syenite are usually long and narrow, and taper towards a point at either end. The terminations are however often imperfect. It was here that one of the attempts, which have already been referred to, was made to burn the nepheline syenite into lime, this rock being mistaken for crystalline limestone. The kiln in which the rock was partially fused stands at the side of the lane near the road, and offers a good opportunity to those desiring unique specimens. About 2½ tons of the corundum-bearing rock from this lot were blasted out and shipped to the laboratory of the Kingston School of Mining for a mill test.

A considerable part of this lot is cleared and fenced into fields, so that one would not expect the exposures of rock to be very numerous. To the northeast of the house however, and near the woods, there is a considerable exposure of nepheline syenite. This is several hundred yards north of the outcrops which have just been referred to. Numbers of large angular blocks of rock, some of which are rich in corundum, lie to the north of the house and farm buildings and to the north of the outcrops near the roadside, from which they could not have been removed by glaciers. On removing the covering of soil doubtless considerable corundum-bearing rock would be exposed. On this lot also good specimens of nearly white corundum can be obtained, the ordinary color of the mineral on the other lots in the townships referred to being brown or gray.

Numerous boulders, some of which are of large size, lie along the hillside on and at the edge of the road. Boulders holding the mineral are also quite numerous in a valley-like depression which stretches south from the outcrop, whence they have doubtless been transported by glacial action. It was through these transported boulders that the deposit was first found. They were seen at the roadside about a mile south of the deposit, and were followed north until the rock was reached in place. Other deposits were found in the same way during the summer, in most cases search meeting with success after following the boulders up for less than a mile.

Corundum boulders.

On lot 31 in the second concession of Radcliffe corundum occurs in a pink colored rock, which is somewhat laminated in structure, on the face of a cliff at the edge of the woods.

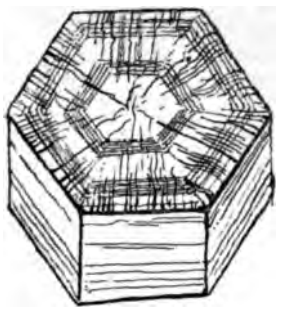
Corundum crystals from Carlow, Raglan and Brudenell—5-12 natural size (p. 215).

Narrow dike of corundum-bearing syenite cutting dark gneiss, from Carlow (p. 211).

Crystals of Beryl in felspar with Columbite on smooth face in upper left hand corner, from lot 23, con. XV, Lyndoch—1-3 natural size (p. 234).

Corundum crystal from Brudenell—natural size (p 215.)

Corundum crystal from Brudenell—natural size (p. 215).



CORUNDUM CRYSTALS.

1. Isomorphous layering. From Tschermak's Mineralogie (p. 216). 2. Rombohedral plate on basal plane of prism Crystal from Carlow (p. 216).

Magnetite in place of corundum, in syenite.

Corundum crystals in nepheline syenite, from lot 34, con. V, Brudenell—1-3 natural size (p. 216).

Emery: mixture of coarse grains of magnetite and light colored corundum, from Brudenell—3-4 natural size (p. 2

Lower dam and bridge at Palmer's Rapids on the Madawaska river (p. 219.

Section of lower dam and bridge at Palmer's Rapids (p. 219.)

3 Nodules of mineral of the Columbite group in felspar, from lot 23, con. XV, Lyndoch—5-6 natural size (p. 235).

4. Thin layers of mineral of the Columbite group in felspar, from lot 23, con. XV, Lyndoch—5-11 natural size (p. 235).

The cliff can be seen from Mr. Schröder's house. The width of the band of rocks here which carries the mineral is 12 or 15 feet, and it is exposed for some distance along the edge of the cliff. Had it not been for a recent fire, which removed the brush and part of the soil, the exposure might have escaped notice,—a fact which illustrates that work will have to be done in removing the surface covering at many of the deposits referred to in this report before an opinion can be formed concerning their extent.

Lyndoch and Sebastopol.

Corundum-bearing rock in Lyndoch and Sebastopol.

Corundum-bearing rock was found in place on lot 13 in the fourteenth concession of Lyndoch, and on lots 6 and 24 in the fourth concession of Sebastopol. It was also found on lot 25 in the fifth concession of Sebastopol, and on two or three adjoining lots whose exact numbers could not be easily determined. Coarse nepheline syenite is exposed at the side of the road on lot 11 in the fourteenth concession of Lyndoch. This exposure of rock has a considerable breadth. At this point the rock does not carry corundum, but it was decided to trace up the dike or mass, as by former experience it had been found that nepheline syenite passed into syenite in which nepheline was absent. After following the strike of the rock towards the west for some distance it was found to contain less nepheline, until finally this mineral was not observable on weathered surfaces of the rock. At this point the rock was found to possess considerable magnetite in fairly well formed octahedral crystals, some of which were about half an inch in length, and a short distance further on the rock was seen to be corundum-bearing. This portion of the rock occurs on the north end of lot 13 in the fourteenth concession, at the east end of a small lake. There is here an exposure of rock of considerable extent in which corundum occurs. Time did not permit of an examination of lots immediately to the west, but it is likely the mineral occurs on some of them as well.

The nepheline rock was also traced eastward from the road and was found to die out on lot 6 in the fourteenth concession, but here the surface is pretty well covered with soil and part of the lot is occupied by a small lake, and no corundum was found.

On lot 6 in the fourth concession of Sebastopol corundum occurs sparingly in the rock at the top of a cliff across the road from some farm buildings. Crystalline limestone, trap rock and coarse quartziferous pegmatite form part of the cliff. It may be stated that the rock at places between this lot, and lot 13 in the fourteenth concession of Lyndoch has the same general appearance as the rock in which corundum is found. None of the mineral was observed here, although it is likely that if we had had more time at our disposal we would have discovered deposits of the mineral.

Lot 24 in the fifth concession of Sebastopol is rather difficult of access, being situated at some distance from a road and in a rough piece of country, as indeed are many of the lots referred to in this report. Boulders of rock holding corundum were found about a mile to the south of this lot, and they were followed north until the mineral was found in place in the face of a high hill. There is an exposure of rock containing corundum here of considerable extent and the mineral is present in fair quantity.

Lot 25 in the fifth concession is situated on a hill which is one of the highest and most difficult of access in the whole district. This hill lies a short distance south of lake Clear. There is a considerable development of corundum-bearing rocks on this and adjoining lots, but as the examination of this part of the district was made at the end of the season there was not time to make a thorough examination of the lots. Several exposures of the interesting rock nepheline syenite were observed. On account of the rough character of the locality it was not possible in the time at our disposal to determine the number of some of the lots definitely, traces of surveyor's lines here as in other parts of the district having been destroyed by fire during the years which have elapsed since the surveys were made.

The finding of corundum in the township of Sebastopol adds another mineral to the interesting list of those previously known to occur there. Some specimens of minerals

from this township are to be found in collections in different parts of the world. This is owing largely to the enthusiasm which the well known collector Mr. Alexander Parks has shown in the work of collecting. Twin crystals of zircon and large sphenes are probably the best known minerals from this locality.

A famous locality for rare minerals.

Numerous travelled boulders of nepheline syenite were observed in the townships of Lyndoch and Sebastopol to the south and southwest of lake Clear. It was at first thought that these boulders probably came from a mass of rock situated in Sebastopol, but on tracing them up they were found immediately to the north and northwest of lake Clear and beyond, though we did not succeed in locating the mass of rock from which they came. The position of the lots on which corundum was found in these two townships is south of where the boulders were situated. The breadth of the strip of country over which these boulders of nepheline syenite are pretty thickly scattered is over three miles. In most parts of the district where boulders were found the parent mass was located a mile or two to the north, in the direction of the glaciation, and it is likely that the mass from which these numerous nepheline syenite boulders were detached will be found on carefully following up the track of the glacier in some of the townships immediately to the north or northwest of lake Clear. Judging from the number of boulders and the width of the strip of country over which they are scattered, the mass of rock from which they were detached must be of considerable size. It would be well to search for it both for the scientific interest it is likely to have and on account of the probable occurrence of corundum in it or in its associated rocks.

A region of nepheline boulders.

In Carlow Township Again.

After having traced the band of rocks in which the corundum occurs eastward to the south of lake Clear in Sebastopol, from what may be called the original lot or locality in Carlow (lot 14 in the fourteenth concession), on which Mr. Ferrier reported the mineral to occur, it was thought advisable to determine whether the mineral was to be found in the western part of this township. We were successful in tracing these rocks westward to near boundary of Carlow and Monteagle, which the is near the valley of Papineau creek. This valley is somewhat wide and the rocks on either side are pretty well obscured by loose sedimentary deposits which hinder the search for the mineral. Several rocky hills which are situated not far east of the creek were found to be of an acidic character, thus giving no indication of carrying corundum. It seems not unlikely however that corundum does occur to the west of the creek, in the northern part of Monteagle and the adjacent part of Wicklow, although we did not find it in the little time we were able to give to the work in either of these two townships. The mineral was however found in Carlow west of lot 14 in the fourteenth concession, on lots 10 and 11 in that concession, and lots 8 and 10 in the fifteenth. Difficulty was found in determining on what lots these four occurrences are situated, as the township was surveyed years ago and little traces of the lines remain, as the district has been subjected to heavy forest fires. For this reason the situation given of one or two of these occurrences is only approximate. Lot 8 in the fifteenth concession is occupied by Mr. Jessup, and the mineral is found on the north end of the lot. There is also an occurrence on the end of a ridge which runs east from the southern part of lot 8 in the fifteenth concession. Comparatively low land lies between this end of the ridge where the outcrop occurs and the outcrop on lot 14 in the fourteenth concession. The end of the ridge was thought to be on lot 10 in the fourteenth concession. A little to the east of this is another outcrop on a knoll which was thought to be on lot 11 in the thirteenth or fourteenth concession. The outcrop on what was thought to be lot 10 in the fifteenth concession is on the side of a rocky hill which is light in color and can be seen for some distance. The mineral is also found in place on lots 15 and 16 in the sixteenth concession. On the latter lot some of the rock exposed holds a high percentage of corundum.

Exploring the western part of Carlow township.

Lot 14 in the fourteenth concession, which may be called the original corundum deposit

of the district, has already been referred to several times in this report. The outcrop first discovered[15] is situated near the side of a lumber road and is distant about 75 yards from a creek. This outcrop occurs on the face of a cliff at the lower part of a sloping face of one of the highest hills in the district. The corundum-bearing rock is in part coarse grained and pink in color; in part fine grained and gray in color. No nepheline was observed in hand specimens of the rock, and quartz is also absent. The corundum-bearing rock cuts brown gneiss and can be traced somewhat diagonally across the strike along the face of the cliff for about 100 yards, and shows along the strike up over the cliff for about twice this distance. Dikes of quartziferous pegmatite cut the gneiss on either side of the corundum-bearing rock. This deposit being thus situated on the face of a cliff gives a better opportunity of judging of the size than do those deposits which occur on lower ground where the surface is often covered with soil. The percentage of corundum carried by this rock has not been stated, as the writer thought it better to wait for the result of a mill test on some tons than to attempt a rough estimate which might be misleading.[16] In making an estimate of the mineral in a specimen of the rock two factors have to be taken into consideration, viz., volume and specific gravity, the corundum having a considerably higher specific gravity than the felspar with which it is associated. Moreover the mineral is more or less segregated into patches and stringers, and the only test which would seem to be of much commercial importance is the treatment of some tons of the rock. For this reason about 3½ tons of the rock were taken out and treated in the mill of the Kingston School of Mining, an account of which is given by Prof. DeKalb.

Observations on the original discovery.

Outcrops of the mineral were observed on the summit of the hill some distance east of this one, and also on the side of the hill facing Foster lake and about one mile north of the lake.

Other outcrops in Carlow.

In Raglan and Bangor.

Outcrops of rock carrying corundum, some of which were of considerable size, were also discovered on a number of the lots lying between lot 14 in the fourteenth concession and the northwest corner of the township of Raglan. The hills are for the most part covered with brush and soil, and it is generally only on the steeper part of their sides that the outcrops can be detected. Our work showed however that most of the lots lying between the two points referred to contain the mineral in place.

Six or eight lots in the northwest corner of Raglan exhibit outcrops of corundum. These lots are numbered from one to five in the eighteenth and nineteenth concessions respectively. The line between these concessions here runs along the steep face of a high hill. The more important outcrops are on lots 1, 2, 3 and 4 in the nineteenth and on 3 and 4 in the eighteenth, and on the concession line. The rock containing the highest percentage of the mineral lies on the concession line and on either side of this line, i. e., on the south parts of the lots referred to in the nineteenth concession and on the north parts of the lots in the eighteenth. Lot 4 in the eighteenth concession probably contains more of the corundum-bearing rock than any of the other lots. On part of the road allowance, where however no road is likely to be constructed on account of the character of the hillside, the rock is rich in the mineral. As would naturally be expected, all degrees in size of grain or crystal of corundum are seen on these lots. One of the largest specimens of the mineral

Deposits in Raglan

[15] Summary Report Geological Survey of Canada, 1896, and Sixth Report of the Bureau of Mines, Ontario.

[16] As it is with the statistics of the corundum industry, which have already been referred to, so it is with information on certain points on corundum deposits. It is difficult to get much information from government reports on the percentage of mineral carried in the rock of foreign deposits. The only reference which the writer remembers meeting with concerning this point is contained in the Mineral Resources of the United States, 1893. In speaking of the Socrates mine of North Carolina it is stated that the vein is two to six feet wide and the vein material averages 15 per cent. corundum by a mill run. It is further stated that at the Bad creek mine in the same district the vein is from four to 15 feet wide and that the vein averages probably 10 to 15 per cent. corundum.

which have been obtained weighed, about 24 pounds. On lot 1 corundum occurs in nepheline syenite, this rock being a facies of the rock which ordinarily carries the mineral in the district. On a steep face of the rock crystals of the corundum were observed arranged in the rock with their longest axes in a vertical position, appearing as if the individuals after having been formed had thus arranged themselves in the molten mass, from which they crystallized before it had soldified.

The face of the hill referred to has a southern exposure, and in the valley or low land below is a stream on which is situated a small sawmill. These lots are not far off the road, and are situated about four miles from the village of Combermere.

The mineral was also found in place on lot 25 in the first concession of Bangor.

Only brief descriptions have been given of the occurrences of corundum on the lots to which reference has been made. On most of them rock can be obtained carrying as high a percentage of the mineral as that which has been treated at the mill. It has been shown that the mineral occurrs pretty widely distributed in the district, so that if other conditions are favorable for the development of the deposits there are many to choose from.

Conditions of Occurrence.

The conditions of occurrence are much the same throughout the band of rocks, practically the only variation in the occurrence of the mineral being the existence of outcrops of nepheline syenite here and there at points in the band. None of this rock was found in place in Carlow, judging from hand specimens, although a careful examination of thin sections of the gray varieties of the rock by means of the microscope might show the mineral nepheline to be present in subordinate amounts. Starting from the western end of the band, nepheline syenite is first found on lot 1 in the nineteenth concession of Raglan; east of this there are outcrops of the rock on lots 34 in the fifth and 34 in the seventh concession of Brudenell, over eight miles distant from the Raglan outcrop. Seven or eight miles southeast of the Brudenell outcrop the rock is found in place in the fourteenth concession of Lyndoch, and 9 or 10 miles east of this it is in place in the fourth and fifth concessions of Sebastopol.

Outcrops of corundum in nepheline syenite.

Origin of the Corundum.

In some parts of the world where corundum is found as a constituent of igneous rocks it is claimed that the molten material from which the rocks originated dissolved parts of other rocks in its passage through them, and these rocks being highly aluminous caused the molten material to contain an excess of alumina, which crystallized out as corundum on the cooling of the material. Hence it might at first appear that the nepheline syenite and what has been called in this report ordinary syenite (hornblende or mica syenite) belonged to different periods of eruption, the excess of alumina found in each being accounted for by the fact that the two kinds of igneous rocks cut through the same strata in their passage towards the surface. However, as has been previously stated, the one kind of rock is seen to run into the other along the strike of sometimes quite narrow dikes, the nepheline being occasionally segated into patches in the felspar.

It does not seem more necessary to attempt to explain the occurrence of corundum in syenite through the solution of pieces of highly aluminous rock than it does to so explain the presence of free silica in granite through the absorption of highly silicious rocks.

In seeking for an explanation of the presence of the excess of alumina (corundum) in the syenites, we may refer to three possible origins of the rock. The rock matter may be re-fused sedimentary material, or it may represent a part of an original magma high in alumina, or again the excess of alumina now in the syenites may be due to the absorption of portions of basic rocks by the molten material which crystallized into the syenites on the passage of this material upward towards the surface.

Three possible theories of origin.

The outcrops of syenite in the townships of Dungannon, Faraday and Glamorgan, which have been examined and described by Dr.

Adams and Mr. Barlow, have not been found to contain corundum. The writer has not examined these outcrops carefully, and the gentlemen referred to do not state what rocks these syenites cut through. It is stated in speaking of one outcrop of nepheline syenite that "The mass occurs in the Laurentian and is flanked on the south along a considerable part of its course by crystalline limestone. It is in many places intimately associated with a fine grained reddish biotite granite resembling aplite in appearance and which is apparently intrusive."[17]

The dark gneiss which the corundum-bearing rock cuts through at the deposits examined in Methuen and at many of those in Hastings and Renfrew, over 40 miles to the northeast, has a pretty uniform character throughout the district. Specimens of this rock from Carlow and other townships were found to range in silica from 47 to 53 per cent.

The following statement of analyses shows the percentage of silica and alumina in three specimens :

	SiO_2	Al_2O_3	Fe_2O_3
I.	48.78	20.77	3.97
II.	48.14	20.54	3.76
III.	50.34	18.75	

Nos. I and II are analyses of specimens taken from a lot in Brudenell, and were made by Mr. J. Walter Wells. No. III is an analysis of the gneiss through which the syenite cuts at the Miller mine in Methuen, for which I am indebted to Prof. Nicol.

It would appear that the percentage o alumina, both free and combined, in the whole body of syenite dikes and masses of the district does not exceed that commonly found in masses of nepheline syenite, which, judging from ten analyses of specimens of this rock from different parts of the world, averages about 22 per cent. The alumina in other syenites—mica, hornblende and augite —taken together averages probably 16 or 17 per cent.

Thus there is a difference between the alumina contents of nepheline syenite and other syenites of, on the average, something like 5 per cent. Since corundum is absent in parts of some of the dikes and masses, and is absent or very sparingly present in the whole of other dikes or masses, it may be safe to assume that the percentage of free alumina (corundum) in all of the syenite of all kinds in the district is less than 5. In considering the origin of the corundum the question then arises—did that part of the magma from which the syenites with their contained corundum originated possess a chemical composition similar to that of nepheline syenite, and would this magma under the proper conditions have crystallized into a mass composed largely of nepheline syenite with no free alumina, or was the part of the alumina now existing as corundum originally a constituent of nepheline or other mineral and was this mineral decomposed, giving rise to less highly aluminous silicates and corundum ?[18]

Nepheline itself contains about 35 per cent. of alumina and the acidic felspars about 20 per cent. Some of the syenite masses of the district contain a very high percentage of nepheline while others consist largely of acidic or alkali felspar, nepheline being absent, and in these more highly felspathic masses considerable corundum is sometimes present. It may be said that the characteristic difference between the larger highly nephelinic masses of the district and the other syenites is the absence of corundum in the former.

Corundum in Peterborough.

Conditions of occurrence.

The occurrence of corundum in the township of Methuen, county of Peterborough, has already been referred to. This occurrence is situated about 40 miles to the southwest of the deposits in Carlow. The mineral occurs here under similar conditions to those under which it occurs in the counties of Hastings and Renfrew. It was observed both at what

[17] F. D. Adams, Am. Journal of Science, July, 1894.

[18] Fouqué and Lévy found (Synthèse des Mineraux et des Roches, p. 63) that when three parts of nepheline were fused with 1.3 parts of augite both minerals crystallized out on the cooling of the molten mass. When however a mixture of 10 parts of nepheline to one of augite was fused, augite was not reformed, but the mass contained fine crystals of nepheline, small octahedrons of spinel and dodecahedrons of garnet (melanite).

is known as Bennett's mine, lots 14 in the ninth and tenth concessions, and at Miller's mine situated across a small lake from Bennett's.

At Bennett's mine pits have been opened in the coarse-grained syenite for the extraction of light colored mica, which is here one of the important constituents of the rock. The largest of these pits is situated at the foot of a hill near the shore of a small lake, and others have been opened higher up the hill. Corundum is found in some of these openings. The color of the mineral in some of the openings is blue and the mineral is at times sub-translucent, approaching the character of the gem variety sapphire more closely than do specimens obtained from any of the localities in Hastings or Renfrew. Brown and gray varieties of the mineral are also found on this property. Some of the corundum-bearing rock in the hill contains nepheline in coarse grains or rough crystals. The corundum here as elsewhere is often much altered into light colored mica and related minerals. It also frequently shows a somewhat striking bronze-like lustre on weathered surfaces, as do also specimens from Hastings and Renfrew. In places the rock has a laminated structure.

Miller's Mine.

The Miller mine situated on an adjoining lot possesses similar geological characteristics, corundum occurring sparingly in syenite dikes, some of which contain nepheline and cut a dark gneiss. Considerable work has here been done in blasting out the rock for the extraction of mica, the rock worked being dikes of syenite. One of these is about four feet wide, and nepheline shows on its surface in coarse grains or patches at intervals along its strike, although the mineral is not observable, megascopically at least, in parts of the dike. The color of the corundum in this dike is blue.

From the fact that these dikes on the two properties spoken of have been worked for mica and also contain some corundum, it seems possible that deposits may be found from which the two minerals may be obtained together in commercial quantities.[19]

As there is a considerable development of the rock on these lots it seems likely that they will be found to form part of a band or belt which will be found to stretch across country for some distance and be similar in character to the band in Hastings and Renfrew.

The writer had very little time at his disposal on his visit to this locality, and no attempt was made to connect these outcrops with others which may occur in the district.

Other Areas of Syenite.

Areas of nepheline syenite.

The first report of the occurrence of nepheline syenite in place in Ontario was made by Dr. F. D. Adams, it having been found by him in 1893, the locality being in the township of Dungannon, Hastings county. This township lies immediately to the southwest of Carlow, the northeast corner of the former township joining the southwest corner of the latter. Nepheline syenite has since been found at a number of points in a band running across this township from east to west, and also in Faraday, a township which bounds Dungannon on the west. About 25 miles to the west of the western boundary of Dungannon, and pretty well in line with the outcrops in this township and those of Faraday, is another occurrence of nepheline syenite. This is on the farm of Mr. McColl, lot 30, in the third concession of Glamorgan, not far from Gooderham station on the Irondale, Bancroft and Ottawa railway.

No discovery of corundum in any of these three townships has been made public, and it seems unlikely that the mineral occurs in many of the outcrops of nepheline syenite as a number of these have been pretty closely studied by Dr. Adams and others, although not with the object of discovering corundum in them, the first place where the mineral was found to occur in this rock being situated in the northwest corner of Raglan, and this occurrence was made known only during the last summer. Many of the coarser grained outcrops of nepheline syenite examined by the writer in what he has roughly called the corundum belt of North Hastings and South

[19] As however white mica (muscovite) and nepheline contain about the same percentage of alumina, 35, the occurrence of much corundum in a highly micaceous rock would be somewhat abnormal. In many of the larger highly nephelinic masses corundum is absent.

Renfrew, did not contain corundum. This rock was however found in most cases to pass into rock in which nepheline was absent or sparingly present, and in such cases the mineral was usually met with. Up to the present the coarser grained outcrops or those holding the highest percentage of nepheline in Dungannon and Faraday, have attracted most attention on account of the rock being of great scientific interest. The percentage of nepheline in some of these outcrops is exceedingly high, and a person having had experience in prospecting for corundum in similar rocks to the northeast would not expect to find it in such outcrops. It seems not unlikely then that corundum does occur in Dungannon and Faraday, but the facies of the rock containing it has attracted little attention, being of a less striking character than that holding a higher percentage of nepheline.

Correlation of Syenite Outcrops.

Parallel bands of the rock.

There are then, as will be seen from the localities referred to, what may be called three bands of rock in which nepheline syenite has been found. The strike of the rock in these bands is roughly east and west, although it varies considerably. The northern band runs through parts of the townships of Carlow, Bangor, Raglan, Radcliffe, Brudenell, Lyndoch and Sebastopol, in all of which townships corundum has been found. Then there is the band stretching through the townships of Dungannon and Faraday, and what may be called a continuation of it in the township of Glanmorgan to the west. In none of these three townships has corundum as yet been reported to have been found, or at least no report of such occurrence has been published. This band lies to the south of and roughly parallel to that of Carlow, Raglan, etc. To the southwest of these again is the occurrence of nepheline syenite in the township of Methuen in which corundum has been found. This occurrence it is thought will be found to be associated with others lying to the east or west of it, and thus we may say that the occurrence of this interesting rock so far discovered in eastern Ontario can be arranged into three roughly parallel bands. The position of the outcrops of nepheline syenite are shown on the small index map which accompanies this report.

Extent of the corundum bearing lands.

The distance between the extreme western and the extreme eastern outcrops of corundum-bearing rock in Hastings and Renfrew, so far discovered, has been stated to be 30 miles. The breadth of the band over which these outcrops have been found varies considerably, but it may be stated that outcrops have been found over an area of something like 100 square miles in these counties, and the mineral rights in nearly the whole of this belt, embracing more than 60,000 acres, are held by the Crown. In the following list of lots, however, the mineral rights were granted with the agricultural rights.

List of lots included in the corundum belt as shown on map, the mineral rights of which have not been reserved in the Crown grants.

Carlow.

S. ½ lots 14, 15, Con. 14.
N. ½ " 6, 7, " 16.
S. ½ " 15, " 16.

Raglan.

Lots 19, 20, Con. 17.
N. ½ lots 3, 4, Con. 18.
Lots 16, 17, 18, 19, 20, Con. 18.
S. ½ lots 1 and 2, Con. 19.
Lots 16, 17, 18, 19, 20, 21, 22, Con. 19.

Sebastopol.

Lots 8 and 13, Con. 4.
" 8, 9, 14, " 5.
" 8, 9, 10, 12, 13, 14, 15, 17, Con. 6.
" 10, 11, 12, 14, Con. 7.

Brudenell.

Lot 27, Con. 1.
Lots 25, 26, 27, Con. 2.
" 24, 25, 26, 27, Con. 3.
" 22, 23, 26, " 4.
" 19, " 5.
" 20, " 6.
" 16, 26, 27, " 7.
" 19, 20, 23, 24, 25, 26, 27, 28, Con. 8.

Lyndoch.

N. ½ lot 23, Con. 15.
Lot 8, Con. 15.
Lots, 23, 24, 25, Con. 16.

Radcliffe.

Lots 1, 2, 27, 28, Con. 1.
" 4, 5, 28, 29, " 2.
" 4, 5, " 3.
" 1, 27, " 4.

The Methuen outcrops in Peterborough county are situated about 40 miles to the southwest of those of Carlow. In the townships referred to in Hastings and Renfrew and in the township of Methuen in Peterborough the corundum-bearing syenites cut through a dark gneiss which possesses the acidity of a gabbro, and so are very closely allied to each other.

Dr. Goodwin's analyses show the corundum-bearing rock treated in the mill to contain in one sample of 500 lb. about 20 per cent. free alumina and about 15 per cent. combined, or a total percentage of 34.95 in the rock. This curiously enough represents the percentage of alumina in the mineral nepheline. The magnetite in the rock was found to average 4.64 per cent. and to be very free from impurities. His analyses also indicate the presence of some rare earth minerals along with the corundum concentrates from the mill run. Some years ago O. A. Derby proved that many gneisses and granites contained monazite, a rare earth mineral, and this mineral has also been found in certain syenites.

A number of points connected with the corundum industry have not been referred to in this report as it was thought they could be more properly treated of in connection with the mill test.

Literature of Corundum.

Valuable information on corundum will be found in the following monographs :

"Corundum and the Basic Magnesian Rocks of Western North Carolina," by J. Volney Lewis. Published by the State Geologist, Raleigh, N.C., 1895.

"Corundum Deposits of Georgia," by Francis P. King. Published by the State Geologist, Atlanta, Ga., 1894.

"The Rubies of Burma and Associated Minerals; their Mode of Occurrence, Origin and Metamorphoses. A contribution to the History of Corundum," by C. Barrington Brown and Prof. J. W. Judd. Phil. Trans. of the Royal Society of London, 1896.

Among other publications that should be consulted on the corundum industry are The Mineral Industry, vols. I to VI, Scientific Publishing Co., New York, and The Mineral Resources of the United States, U. S. Geological Survey, Washington, D.C.

Other Minerals

In the autumn of 1895 the writer made an examination of a number of trap dikes of the county of Frontenac and adjoining counties in eastern Ontario. One of these dikes, which cuts the graphite-holding crystalline limestone near the edge of the Rideau canal in the vicinity of the village of Seeley's Bay, attracted especial attention on account of its strongly marked columnar structure, and it was decided to make a complete chemical and microscopical examination of the rock.

Nickel in Titaniferous Magnetites.

Mr. R. W. Brock accordingly undertook a chemical examination of the rock and found it to contain, among other things, 0.612 per cent. of nickel and 46.51 per cent. of silica. It occurred to the writer that since the dike referred to contained such a comparatively high percentage of nickel the coarse grained basic rocks of the district, the gabbros, might also contain more than the usual amount of this metal. Moreover it was believed that if the theory held by some geologists concerning the origin of the deposits of titaniferous magnetite which are associated with these gabbros were true, then the magnetites themselves would be found to be nickeliferous. The theory is that the gabbros and the associated titaniferous magnetites are both of igneous origin, in any one case the gabbro and accompanying magnetite having both been formed from the cooling of one molten mass. Mr. F. J. Pope, M. A., at the writer's suggestion, undertook an analysis of specimens from a number of these titaniferous magnetite deposits in eastern Ontario and found the ore to be nickeliferous in every case examined. Samples of non-titaniferous magnetites from deposits which showed no evidence of an igneous

Deposits of Titaniferous Magnetite.

origin were on the other hand found to be non-nickeliferous. The percentage of nickel, together with in some cases a little cobalt, in the specimens examined by Mr. Pope varied considerably, as did also the percentage of titanium.

More recently Mr. O. S. James, B.A.Sc., examined specimens from two other localities for me. One of these from the township of Glamorgan gave Mr. James 0.7 per cent. of nickel (and cobalt). Some years ago Prof. Chapman made an analysis of a sample of ore from this deposit and found it to contain 0.06 per cent. of sulphur. Since Prof. Chapman's analysis shows the ore to be so low in sulphur, it seems very improbable that the entire amount of nickel found in the sample examined by Mr. James occurs as a sulphide. It cannot be claimed however that Mr. James' analysis indicates the average percentage of nickel in the ore, as only one specimen was examined by him.

In the dike which has been referred to, samples of which were analyzed by Mr. Brock, the percentage of sulphur is only 0.16, while the percentage of nickel as before stated is 0.612, showing that in this case also little of the nickel exists in the rock as a sulphide. In both these cases the nickel likely exists chiefly as an oxide in association with iron, or as a silicate. In the dike rock referred to there is considerable magnetite. A sample of ilmenite from Baie St. Paul, Que., was found by Mr. James to contain 0.6 per cent. of nickel.

The writer's reason for referring to the occurrence of nickel in titaniferous magnetites in this report is owing to his belief that the matter might be of economic interest.

At the present time little use is made of titaniferous ores although it is generally admitted that iron smelted from them in the past was of a superior quality. It is held by some authorities that "the verdict against titaniferous iron ore has been based on insufficient grounds." It has also been stated that "these ores yielded in England a forge iron which brought double the price of common iron," and "it (the iron) went to the armor plates of Sheffield on account of its toughness, which this iron not only possesses but imparts to others in admixture." Mr. A. J. Rossi, of New York, in quoting these statements, says: "It is not our intention in this article to examine the cause of this superiority. In a general way we may say that, if it is due to titanium in the pig metal, very small quantities of this substance are then sufficient to secure such results."[20] It seems to the writer that, if this superior quality of iron smelted from titaniferous ores is due to the presence of a small amount of any substance in the iron, the substance is more likely to be nickel than titanium, since the metal is present in all the ores of this class which he has had examined. That some of the nickel contained in such ores comes down with the iron on smelting them is proved by some analyses which have been made for the writer by Mr. James. It was found very difficult to get samples of pig iron which had been produced from titaniferous ores, but one sample of iron produced from a mixture of titaniferous and other ore in Quebec was found to contain 0.22 per cent. of nickel, and a sample from New York State was found to contain 0.20 per cent. No specimens of the ore from which this pig iron was produced were examined, and the percentage of nickel in them may have been much less than in the titaniferous ore to which reference has been made.

Superior quality of iron smelted from titaniferous ores, and probable cause of it.

Mr. William Lawson, B.A.Sc., kindly undertook a dry assay for me of a titaniferous magnetite containing about 0.1 per cent. of nickel. The method followed was that given in Kerl's Assayer's Manual, second American edition, pp. 300 to 315. After the metals (iron and nickel) had been extracted, in the form of a metallic button, an alloy of the two metals, from the ore by fusing the latter down with fluxes in a crucible, a portion of the button was dissolved and the percentage of nickel in the alloy was determined by means of wet reagents. It was found that nearly all the nickel contained in the ore had been extracted in the metallic form along with the iron in the button. According to Kerl this method of assaying iron ores by fusion with fluxes "gives a very fair and accurate idea of what may be expected of any

[20] The Iron Age, Feb. 6th and 20th, 1896.

particular iron ore in a blast furnace, not only as regards the yield of iron, but also the composition and action of the fluxes."

It is claimed by some authorities, as has been already stated, that titaniferous ores have been unjustly condemned, and that the difficulties encountered in smelting them have been unduly magnified. If such be the case and they could be used as ores, this presence of nickel in them ought to add considerably to their value. Iron produced from them is admitted by all to be of a high quality, and if this iron contained even a small percentage of nickel, which it has been shown to do, the value of the pig metal would be increased. At the present time metallic nickel sells at about 35 cents per pound. At this price of nickel, especially when we consider the comparatively low price at which iron now sells, the presence of even a small percentage of the metal in iron would be worthy of attention, as the alloy might be used directly in the production of nickel-steel. In such a case less nickel would require to be added to the iron in the process of making steel. A proportion of 0.7 per cent. of nickel, the amount in the specimen referred to, in an ore would represent a value of about $4.50 per ton of ore if all the metal could be extracted in smelting, and if only half of this value in nickel were extracted the value of the resulting iron would be considerably increased for use in nickel steel.

The presence of nickel in the ore as an element of value.

It seems not unlikely that deposits of titaniferous iron ore exist which contain a considerably higher percentage of nickel than those referred to, just as some pyrrhotite deposits in the Sudbury district and elsewhere contain much higher percentages of this metal than do others.

Molybdenum and Uranium.

A mineral to which the writer's attention has been frequently called in eastern Ontario, and of which he has been shown numerous specimens by prospectors, is molybdenite—the ore of molybdenum. Many persons have asked if there was a market for the mineral. Up to the present there has been little demand for it. More attention appears to be directed to the metal recently for use as an alloy with steel. It is claimed that molybdenum and some other metals have an effect on steel similar to that of nickel when alloyed with it. In a short article on the subject in the Engineering and Mining Journal of New York, March 19, 1898, it is stated that "Some mention has been lately made in foreign papers of a new process for making armor plate. . . . The French Government has bought the right to use this process from the inventor, but the details have been carefully kept secret. . . . Enough is known of the process to say that it requires the use in making the steel of some of the rare metals, molybdenum, uranium and vanadium, which take the place of nickel in the alloy used. We are informed by a correspondent who has made many researches into the rare elements that agents believed to be acting for the French Government are now in this country in search of deposits from which these metals can be obtained." Compounds of molybdenum are used as chemical reagents, and in giving brilliant blue colors to pottery, and also in coloring silks and woolens. Within the last five years or so it has been found possible to produce metallic molybdenum in a much purer form than formerly for commercial purposes.

Molybdenum as an alloy with steel.

Molybdenite is apt to be mistaken for graphite, and vice versa, by persons slightly acquainted with the mineral. It is composed of 59 per cent. of the metal molybdenum and 41 per cent. sulphur.

Molybdenum has been found at many places in eastern Ontario. Some of the localities where it occurs are lot 22 in the second concession, lot 7 in the ninth, and other lots in the township of Ross, in Renfrew county. It has also been found on lot 14 in the fifth concession of North Crosby, in Leeds, and at numerous other places in our Laurentian rocks.

It is interesting to note that uranium also occurs in the eastern part of this Province. A mineral, uran-ochre, was found many years ago lining fissures in magnetic iron ore on lot 11 in the fifth concession of Madoc, in Hastings county. In a letter on Iron Ores of Ontario, Prof.

Presence of uranium and chromium in iron ores.

E. J. Chapman, late of the University of Toronto, said: "I have obtained certain somewhat curious results which do not appear to have been hitherto recognized, and which may perhaps interest some of your readers, more especially as these results may not be without practical bearings on the value of Ontario ores. It has long been known that some of the ores in the iron districts of Ontario are more or less titaniferous, the percentages of titanium being in certain examples so high as to render the ore unmerchantable, whilst in others it is sufficiently low to be practically of no account. I now find that in almost every non-titaniferous magnetite from this region (chiefly counties of Haliburton, Victoria, Peterboro', Hastings, Frontenac and Addington) traces or small amounts of either chromium or uranium are present, in addition of course to the normal components, ferrous and ferric oxides. Delicate coatings of hydrated uran-ochre were observed about thirty years ago by Dr. Sterry Hunt on the sides of narrow fissures in the Seymour iron deposit of Madoc, and this substance was discovered a year or two later by the writer, under somewhat similar conditions, lining minute cavities in a magnetic iron ore from Snowdon township in Peterboro'. But the actual presence of uranium as a so-called accidental component of our iron ores seems hitherto to have escaped recognition. So far as my observations go it is only occasionally present; but chromium, on the other hand, although as a rule in very minute proportions is almost invariably a constituent of these ores. But the curious point is this: when titanium is present in an ore both chromium and uranium appear to be entirely absent, and the presence in a magnetite of either of the latter metals appears to exclude that of the other."[21] I have thought it well to quote thus fully from Prof. Chapman's letter as he does not appear to have published his results in any technical journal.

As has already been stated, the titaniferous ores from the region which are referred to by Prof. Chapman have now, in all samples which the writer has had examined, been found to be nickeliferous. The presence of even a small amount of these metals—nickel, chromium and uranium—in an iron ore is of importance if the ore is to be used for the production of steel. If these metals are reduced along with the iron the precentage of them required to be added to form a steel alloy is lessened. Samples of pig iron which the writer has had examined have been found to contain two-tenths of one per cent. of nickel. This amount is small, it is true, but if the iron is suitable for use in nickel steel in other respects this percentage of nickel would add considerably to its value, besides improving its quality. Two-tenths of one per cent. represents four pounds of nickel to the ton, or adds about $1.20 to the ton of iron, a sum worthy of consideration when thousands of tons of such iron are in demand.

Commercial value of chromium and uranium in iron ores.

Tungsten and Vanadium.

The mineral wolfram, which is a tungstate of iron and manganese, was found many years ago by Prof. Chapman in a boulder of Laurentian gneiss on the north shore of Chief's island, lake Couchiching.[22] This boulder was likely carried from the north by glaciers, and it is impossible to say how far it was transported. The distance may have been small or great. Since tungsten is now a substance of considerable value for use in alloy with steel, prospectors among our Archæan rocks should be acquainted with the character of its ore.

Wolfram.

Mr. F. J. Pope, M.A., late demonstrator in the Kingston School of Mining, informs the writer that he finds the titaniferous iron ores of eastern Ontario to contain small amounts of vanadium, and that there appears to be, so far as his work has gone, a relation between the amount of titanium and the amount of vanadium in the ores.

Vanadium.

Iron Ores.

During the last few months there has been some revival of activity in the mining and shipping of iron ores in the eastern part of the Province. Ore has been shipped from a couple of points on the Kingston and Pembroke railroad and from

Revival of iron mining.

[21] The Toronto Daily Mail, Nov. 19, 1890.

[22] Canadian Journal, 2nd Series, vol. i., p. 308, and vol. v., p. 303.

two or three deposits in Hastings county to the Hamilton furnace. Some ore from the vicinity of Calabogie has also been shipped to the Drummond furnace in the Province of Quebec. There is a good prospect of erecting a charcoal furnace at Deseronto this year, and there has also been some agitation for the erection of a furnace in the vicinity of Bancroft, although it may go to a point farther west.

Gold Mining.

Considerable prospecting has been done for gold deposits in Hastings and other counties of this part of Ontario during the last year. This is due no doubt partly to the revival of interest in gold mining which has affected many parts of North America during the last few years, and partly to local causes, the chief of which is the working of the well known Deloro mine in the township of Marmora.

Deloro mine in Marmora.

Lead and Bismuth.

There also appears to be a revival of interest in the ores of lead. Late in 1897 the lead smelting plant which was erected in the city of Kingston in 1879 to treat the galena from a deposit in the township of Loughborough, known as the Frontenac lead mine, was sold to some Toronto gentlemen. They also have the Frontenac mine under lease. Galena occurs in a number of other townships in eastern Ontario.

Bismuthinite, an ore of bismuth, occurs on lot 34 in the third concession of the township of Tudor, Hastings county. The mineral has also been found in the township of Lyndoch, Renfrew county. Some months ago specimens of minerals said to be collected in the township of Barrie, Frontenac county, were sent to the laboratory of the Kingston School of Mining for determination. One specimen sent by John Bey, at Mazinaw lake, proved on examination to be bismuthinite, as did also another specimen collected by C. H. Spencer of Roblin. The metal bismuth is used in making fusible alloys, and some of its compounds are used in medicine. Bismuth is quoted at from $1.30 to 1.80 per pound.

Discoveries of bismuthinite.

Marble and Granite.

Extensive beds of crystalline limestone from which marble of good quality can be produced are known to occur in different parts of the Laurentian area of eastern Ontario. Up to the present however little has been accomplished towards developing the industry, most of the marble used in the Province being imported from the eastern United States. A marble manufacturer informed the writer some years ago that chiefly the poorer grades of United States marble were marketed in Canada. He also expressed the opinion that specimens of Ontario marble shown him were of good quality and that it ought to be possible to develop an industry in the Province. It is difficult however to overcome trade prejudices concerning marbles and some other mineral products. The writer has had some enquiries from manufacturers in eastern Ontario concerning granite suitable for monumental and other purposes. No systematic examination of the granites in this part of the Province has been made, but it seems not unlikely from the great many varieties of the rock that are known to occur here that varieties suitable for different commercial purposes can be found.

Probability of obtaining good samples.

A Mineral of the Columbite Group.

For some years crystals of beryl have been obtained by different mineralogists from Mr. Alexander Parks, the well known collector of the township of Sebastopol, Renfrew county. The location of the deposit from which these specimens came was said to be known only to Mr. Parks and to Mr. J. Sullivan, the discoverer of the deposit. Although the writer had never enquired of these gentlemen where the specimens were obtained, he was told by members of the staff of the Geological Survey, who had purchased specimens, that the deposit from which they were obtained was said to be situated in the township of Sebastopol, but that Messrs. Parks and Sullivan declined for some reason to make the exact location of it known to the public. It seemed to the writer that since the ore of tin is sometimes found associated with beryl the

An occurrence of Beryl in Lyndoch.

deposit might have some economic importance, and moreover the mode of occurrence of the beryl itself would be of interest. For these reasons it was decided to be in the public interest that the location of the deposit should be made known, especially as this could work no injustice to Mr. Parks or Mr. Sullivan. The writer accordingly gave all the information possessed by him concerning the specimens of beryl to his assistant, Mr. R. T. Hodgson, and instructed him to make enquiries concerning the location of the deposit while prospecting for corundum in the townships of Lyndoch and Sebastopol. During the progress of his work Mr. Hodgson met Mr. P. Casey, who informed him that he had come across the beryl occurrence some time before. Mr. Casey promised Mr. Hodgson to show it to the writer, which he did some days afterwards.

The deposit is situated well down the face of a high hill, which faces the Quodville road on lot 23 in the fifteenth concession of Lyndoch, and is several miles distant from the part of the township of Sebastopol, in which it had been supposed to be situated. The part of the face of the hill where the outcrop occurs is covered for the most part to a considerable depth with a layer of soil and boulders. The outcrop itself as now exposed is of small size, being about 15 yards in length. The rock matter on the western end of the outcrop consists of large masses of green felspar or amazon stone and quartz. These minerals show a rather sharp contact, and the masses of them have a diameter of some feet. Associated with these minerals is some black mica and beryl which is imbedded in the quartz. The beryl crystals are of different sizes, being generally much elongated but with imperfect terminations. Some of the crystals have a diameter of six inches. One crystal was seen imbedded in the quartz which had a length of over 30 inches and a diameter of three inches. On the eastern end of the deposit the felspar has a pink or reddish color, and was found on microscopical examination to possess a microcline base through which is set plagioclase, thus making it a microcline microperthite. The surface of this part of the deposit is much broken up, the felspar and associated quartz, which is generally smoky in appearance, being in loose fragments. It is in this part of the deposit that the mineral occurs which has been determined to belong to the rare columbite group.

Rock formation of the outcrop.

On making an examination of the deposit, my attention was at once attracted to this dark colored mineral. It is black in color, possesses a sub-metallic lustre and occurs imbedded in the felspar. The plates conform somewhat closely to the cleavage planes of the felspar and in some cases are of considerable size. In one specimen obtained the diameter of the plate was about six inches, and its thickness one-sixteenth of an inch. The plates in some cases at points on one of their surfaces expand into nodules, which thus possess one rounded and one plane surface. The plane surfaces of the nodules are generally quite smooth and well polished, but the centre shows a tendency to be slightly raised above the other part of the surface. The rounded surface of the nodule is somewhat rough. On the plane surface the nodule is seen to have a strongly marked concentric structure and a fairly well defined, finely radiated structure is also observable. The general appearance of the plane surface of the nodules and the arrangement of the nodules in the felspar can be seen in figure 3 which is a reproduction from a photograph in which a number of nodules of different sizes are shown. The arrangement of the plates in the felspar is shown in figure 4.

Examination of the Columbite mineral.

The specific gravity of one nodule, weighing 7.51 grams, was found to be 5.36. Another specimen consisting of two nodules joined together and weighing 21 grams had a specific gravity of 5.38. Both specimens had a small amount of felspar attached to them, so that the specific gravity given is slightly low, but is believed not to exceed 5.39 or at the most 5.40. This specific gravity agrees with that given for some varieties of columbite. As the specific gravity of the mineral columbite rises, it passes, by substitution of the element columbium (niobium) for tantalum, into the closely related mineral tantalite.

A part of one nodule was pulverized and digested with sulphuric acid. The solution was diluted and filtered. After the addition of hydrochloric acid and metallic zinc to the solution it was boiled, when it took on a blue color which was retained for some time on letting the solution stand. This reaction also serves to distinguish columbite from tantalite, the latter mineral not giving this reaction after being digested with sulphuric acid. Other related minerals however, such as samarskite, give a similar reaction to columbite, but the specific gravity and lustre of the nodules distinguish the mineral from samarskite.

Dr. W. L. Goodwin has made a preliminary analysis of a part of one of the nodules. Owing to the rarity of the constituents of the mineral, and the consequent imperfect methods of separation applicable to them, his results can be considered only as provisional. Pressure of other work has not as yet permitted a complete quantitative analysis of the mineral. Dr. Goodwin states:

"A quantitative analysis, in which however the separations were afterwards shown to be imperfect, indicates the following composition:

Rare acids	75.75	per cent.
SnO_2	0.92	"
FeO	11.14	"
MnO	10.22	"
CuO	0.03	"
Rare earths	2.00	"
	100.06	

Among the rare acids niobic and tantalic were identified. The rare earths present in this mineral include ceria, didymia and the yttria group."

Specimens of the material for analysis have also been furnished to Mr. H. R. Carveth, B.A., Fellow in Cornell University.

Economic interest of the mineral.

The chief economic interest attached to this mineral is connected with the fact that it contains a small amount of the metal tin, and that columbite and the ore of tin, cassiterite, are sometimes found associated. Mr. W. P. Headden states[23] that in the deposits examined by him in South Dakota the columbite is not always associated with the cassiterite, but he has found no columbite where cassiterite did not occur in the same vein—sometimes, though not always, intimately associated with it. The columbite in the Black Hills is also associated with beryl. In connection with the occurrence of the amazon stone and columbite, it might also be stated that columbite has been found associated with the large crystals of amazon stone which occur in El Paso county, Colorado.[24]

These and other points of resemblance among widely separated deposits of columbite and related minerals in different parts of America are of interest.

Other related minerals.

There is also embedded sparingly in the felspar another mineral which has not as yet been subjected to careful examination, but it appears to be a columbate. It has a vitreous lustre, is shining black in color, has a conchoidal fracture and resembles rather closely in general appearance certain specimens of the natural glass obsidian. Its appearance is not unlike that of samarskite. There is also a brown mineral which appears to belong to the same chemical class as the two already described. Some of the plates and nodules of the black sub-metallic mineral described appear to be more or less intermixed with the brown material, which is also probably a columbate. The mineral columbite itself is sometimes of a brown color.

In connection with the black obsidian-like mineral referred to, it is interesting to note that Prof. William Ramsay and Mr. M. W. Travers recently published a paper on the mineral fergusonite,[25] which is a mineral related to columbite, being mainly a columbate of yttrium. Fergusonite is also not unlike obsidian in outward appearance. In referring to their experiments on fergusonite Prof. Ramsay and Mr. Travers state that "its evolution of heat, accompanying its parting with helium, suggest the idea that it is a true endothermic compound of helium." A number of similar minerals contain helium

[23] Am. Journal of Science, vol. xli., p. 90. 1891.

[24] J. L. Smith, "Examination of American Minerals," Am. Journal of Science, vol. xiii., p. 362. 1877.

[25] "Fergusonite an Endothermic Mineral," Proceedings of the Royal Society of London, vol. 62.

which is expelled on the application of heat. It would be interesting to have some of these Canadian minerals from the Lyndoch deposit examined for the presence of this element.

Black tourmaline is quite abundant in the deposit, being sometimes in large crystals which have the prismatic planes well developed. Pink fluorspar is present filling cavities in the felspar, and there is also a little magnetite.

This association of minerals is characteristic of deposits in which columbite and related minerals occur. It is interesting to note how frequently the more characteristic minerals of this deposit—beryl, tourmaline, fluorspar and the rare columbates—are found occurring together.

Another point worth mentioning in connection with this deposit is the form which the pink felspar sometimes exhibits. At times this mineral occurs in thin plates. This structure of the felspar in one of the columbite deposits of the Black Hills of South Dakota has been observed by Mr. W. P. Headden,[26] who states that "this felspar is probably an alteration product, as is suggested by its mode of occurrence and by the fact that the small spodumene crystals which occur in this association have undergone complete change."

So far as the writer knows the Lyndoch deposit is the first deposit in Ontario in which minerals of the columbate or tantalate group have been found. Samarskite was found some years ago in Berthier county, Quebec.[27] Beryl, on the authority of Dr. Bigsby, is stated to occur on the eastern side of Rainy lake, but the reported occurrence does not seem to have been verified by workers in that district in recent years.[28] Other localities in Canada where beryl is known to occur are Brassard and De Maisonneuve in Berthier county, Quebec, and on the north shore of lake Kenogami, Chicoutimi county, in the same Province. Beryl has also been found in a mica deposit at Tête Jaune Cache, Canoe river, B. C.

Other occurrences of Beryl.

Considerable work will have to be done in removing soil and boulders before a complete description of the Lyndoch deposit or of the minerals which occur in it can be given. It seems advisable that some work should be done in opening up the deposit, both on account of its scientific interest and of the possible economic bearing which it may have. Numerous coarse dikes or veins composed essentially of quartz and felspar occur in the district. Some years ago the writer examined dikes of this character in the district some miles south of the Lyndoch deposit. These dikes contained considerable fluorspar and thus would seem to have been subjected to agencies similar to those which have acted on the Lyndoch deposit. Moreover specimens of a rock similar in mineralogical composition to greisen, the rock in which tinstone occurs, have been obtained not far from the locality of these dikes.

Further exploration called for.

Kyanite.

Quite recently while visiting the Golden Fleece mining location, lot 25 in the sixth concession of Kaladar, the writer found the mineral kyanite or cyanite in place on the southern half of the lot. This mineral, while of little economic interest, is of comparatively rare occurrence in this country, and it was thought it might be well to make a note of its occurrence here. Up to within a few years ago the only known occurrence of the mineral in Canada was that of Wahnapitae station near Sudbury. The mineral has also been found on Snake creek, Pontiac county, Quebec, and near Summit creek, Kootenay, B. C. In Kaladar it was found imbedded in small masses or stringers of quartz in a mica schist which is associated with a mass of coarse metamorphosed conglomerate of the so-called Hastings series. The outcrop of the mineral is near the contact of the schist with an area of dark

Occurrence of the mineral in Kaladar.

[26] Am. Journal of Science, vol. xli., p. 90, 1891.

[27] G. Chr. Hoffmann, Am. Jr. Sci., vol. xxiv., p. 475, 1882.

[28] "On the west side of this horn [the northeast arm of Rainy lake, called Seine bay], ten miles from its north end, in a narrow side-bay, four miles long, I found well characterized prisms of beryl, and in two spots; but I had no time for a careful search for more."—The Shoe and Canoe Pictures of Travel in the Canadas, by John J. Bigsby, M.D., vol. ii, p. 265.

basic gneiss, the line of contact being well marked by a narrow valley which runs southward from the point where the shafts have been sunk on the gold deposit. Associated with the kyanite in the quartz is considerable magnetite, and since these minerals occur near the contact with the basic gneiss it would seem as if the iron and alumina might have been derived fro mineral occurs in blade times approach a subfibro of the crystals observed w but some of them exhibit blue color. Fairly well black tourmaline are at the quartz stringers in th

Analyses of Corundum and Corundum-Bea

By W. L. Goodwin

THE analysis of corundum for the determination of alumina, oxides of iron, silica, etc., was made in the usual way by fusion with sodium bisulphate as described by J. Lawrence Smith,[29] but the solution of sulphates was divided, one part being used for the estimation of Al_2O_3 and Fe_2O_3 by precipitation, and the remainder for the estimation of Fe_2O_3 by reduction and titration. The loss on ignition was determined by igniting for two hours over a high temperature burner. The filtrate from the ammonia precipitate was tested for calcium and magnesium, and found in some cases to contain traces. The ammonia precipitate was not treated for the separation of calcium. Another method employed was by fusion with a mixture of eight parts of sodium bisulphate and three parts of potassium acid fluoride. The finely powdered corundum was found to dissolve in this flux very rapidly, but it had the disadvantage of not permitting of the estimation of silica in the same portion. A third method of attack was by evaporation with hydrofluoric acid and a few drops of sulphuric acid, the insoluble part being taken as alumina. This it was proved to be in several cases by fusion with sodium bisulphate, dissolution, and precipitation with ammonia in the well-known way. The iron and alumina were then estimated in the part dissolved by the acids.

Methods of analysis.

Of the following analyses, *A*, of selected corundum crystals, was made by Dr. Adolf Lehmann; *B*, of selected dum concentrates was m and *C*, of corundum crys coarser particl was made b Wells. *A* was with sodium bisulphate a ture of this salt and acid With *B* the hydrofluori used.

Determinations of corundum.

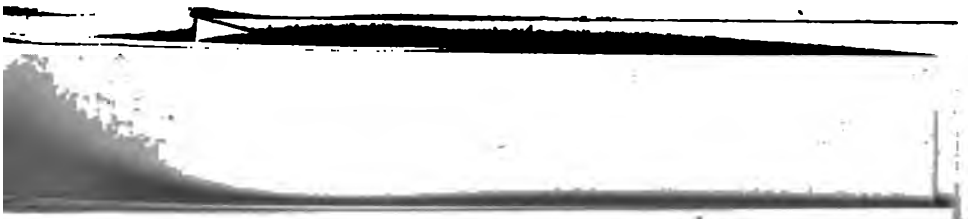
Sample.	Al_2O_3	Fe_2O_3
A	96.92	....
B	96.26	0.36
C	97.27	0.32

The silica was determ in three samples of the and found to be 0.05, cent. respectively. In sample *B* into solution sodium sulphate a small insoluble even after thr small portion of this shown by evaporating wi sulphuric acids. The readily to acid potassiun shown to consist of the c

In the library at our co unable to find a chemic commercial an rock. An atte to work out a n fact that corundum, espe is nearly insoluble in hyd the rock matter, unless i stituents as barium sul soluble. In preparing tl

Preparing the samples for treatment.

[29] American Journal of Science, 2nd Series, X, 366.

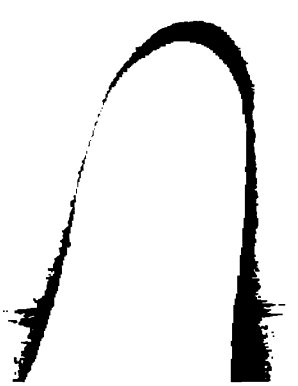


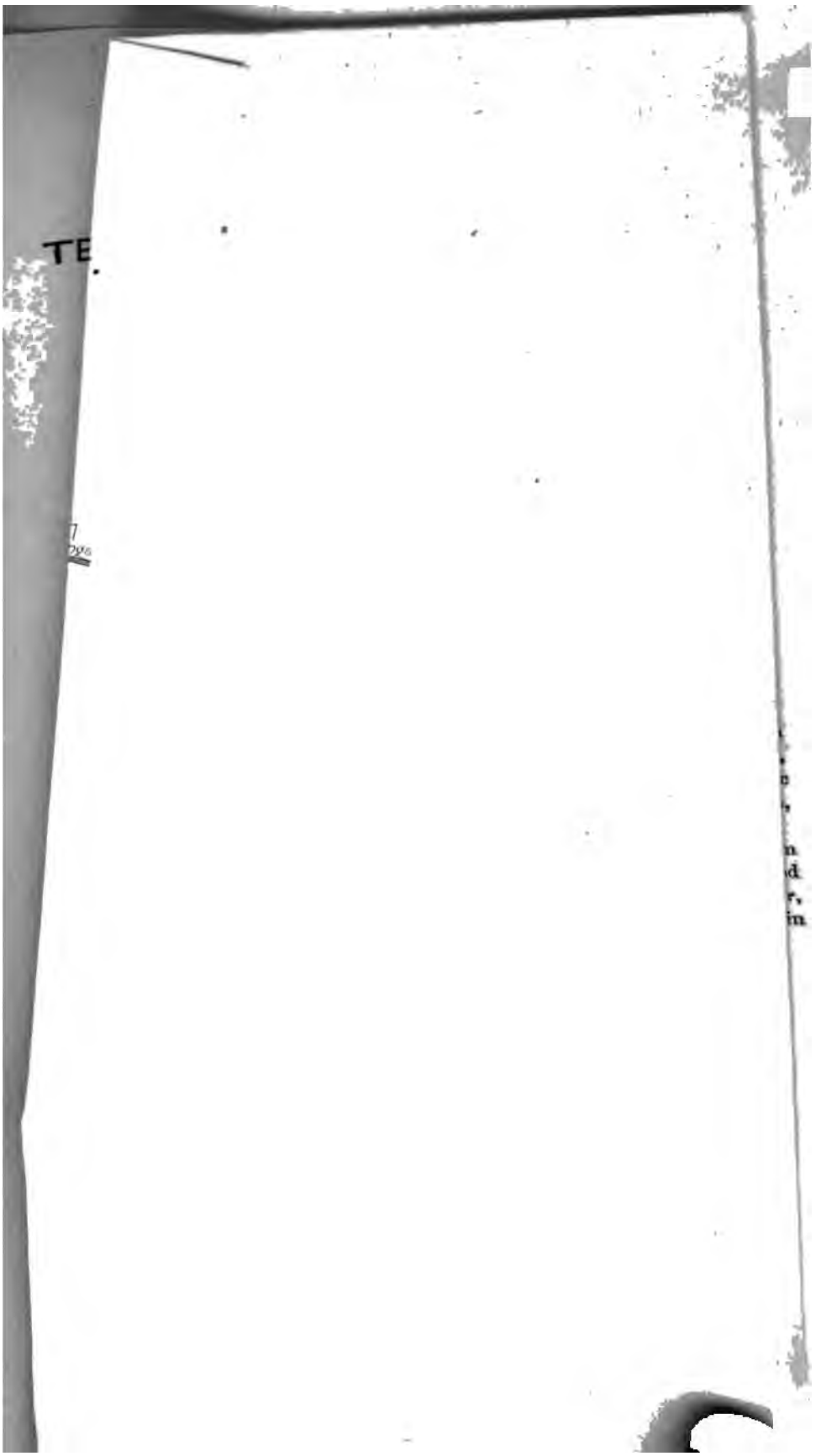
basic gneiss, the line of contact being well marked by a narrow valley which runs southward from the point where the

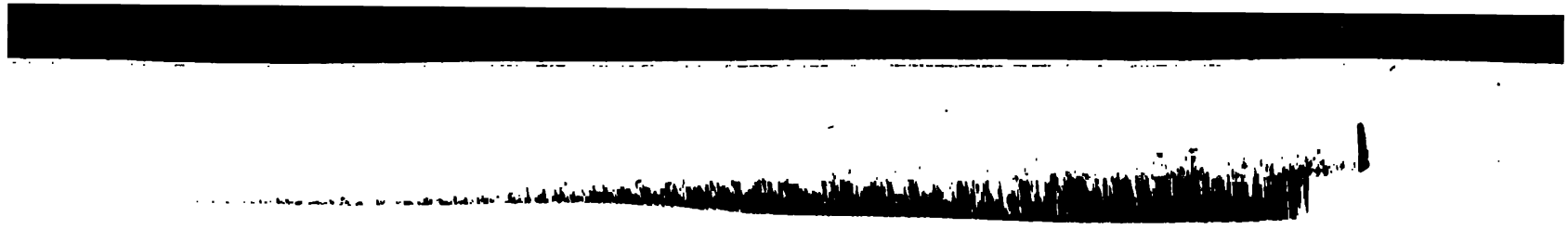
have been derive

mineral occurs in

366.







were either powdered in a dia- tar, levigated, and then purified iron by digesting with acetic was ground in a

Sample A is from a 500 lb. lot submitted to concentration by Prof. De Kalb.

Sample B is from the oversize from the first screening of the 1250 lb. lot (Test B of De Kalb's experiments in concentration),

.e undersize from the 250 lb. lot, represent- st two samples taken e whole lot of rock i would give an average oluble, and of 1.8 per

its the tailings from , which had a specific

ts a lot from Test B e the following treat- $\frac{3}{8}$ in.; 2nd, screened; ugh jigged; 4th, the and separated in a 5th, the spigot dis- he hutchwork screened sh sieve; 7th, the over- the Wetherill magnetic a current of 0.9 ampère tite.

its the cleaned corundum ation mentioned above, h the Wetherill magnetic a current of 16 ampères, ry."

its the hutchwork from A, which had been passed ill magnetic concentrator, of 0.9 ampère, and again 3 ampères.

					SiO_2.	Loss on ignition.
					....	1.29
					....	1.72
					....	1.91
					....	1.65
					2.85	1.58
					....	....
G	95.01	.....	.....	0.38	0.40	2.19 1.80

nt they were either powdered in a dia- nd mortar, levigated, and then purified om metallic iron by digesting with acetic id; or a weighed quantity was ground in a rge agate mortar covered in such a way as to prevent loss. The silica taken up from the mortar was each time estimated by the gain of weight, but as it was volatilised in the subsequent treatment by hydrofluoric acid, this was hardly necessary. The ignited sample is evaporated on a water bath in a platinum dish or large platinum crucible with about 10 c. c. hydrofluoric acid and a few drops of sulphuric, the quantity of each being increased in proportion to the rock matter. The last traces of hydrofluoric acid come away very slowly. The residue is treated with water and a little sulphuric or hydrochloric acid and filtered through a very close filter. The finely ground corundum tends to pass through the filter. The washed insoluble residue is ignited and weighed. Three samples of A1 treated in this way gave 20.10, 20.51 and 19.28 per cent. insoluble. The insoluble residue from the first sample was fused with acid sodium sulphate and acid potassium fluoride, dissolved, and precipitated with ammonia. The precipitate amounted to 20 per cent. of the sample. Trials with samples richer in corundum gave fairly concordant results, although there were occasional large variations due probably to variations in the procedure.

Results of the investigation.

The following tabulated results contain the principal information obtained in the course of this investigation, which is still in progress:

Sample A is from a 500 lb. lot submitted to concentration by Prof. De Kalb.

Sample B is from the oversize from the first screening of the 1250 lb. lot (Test B of De Kalb's experiments in concentration), representing 698 lb.

Sample C is from the undersize from the same screening of the 1250 lb. lot, representing 552 lb. These last two samples taken together represent the whole lot of rock treated in Test B, which would give an average of 15.69 per cent. insoluble, and of 1.8 per cent. loss on ignition.

Sample D represents the tailings from the jigging in Test A, which had a specific gravity of 2.695.

Sample E represents a lot from Test B which had undergone the following treatment: 1st, crushed to $\frac{3}{8}$ in.; 2nd, screened; 3rd, the oversize rough jigged; 4th, the hutchwork crushed and separated in a hydraulic classifier; 5th, the spigot discharge jigged; 6th, the hutchwork screened through a No. 30 mesh sieve; 7th, the oversize passed through the Wetherill magnetic concentrator, using a current of 0.9 ampère to remove the magnetite.

Sample F represents the cleaned corundum from the last operation mentioned above, passed again through the Wetherill magnetic concentrator, using a current of 16 ampères, to remove the "emery."

Sample G represents the hutchwork from the jigging in Test A, which had been passed through the Wetherill magnetic concentrator, first with a current of 0.9 ampère, and again with a current of 16 ampères.

Sample.	Insoluble.	Soluble Al_2O_3.	Total Al_2O_3.	F_2O_3.	SiO_2.	Loss on ignition.
A	19.96	14.99	34.95	9.41	....	1.29
B	19.16	16.19	35 35	9.71	....	1.72
C	11.32	.....	.....	....	....	1.91
D	2.87	.....	.....	....	....	1.65
E	90.76	2.45	93.21	1.64	2.85	1.58
"	.....	.....	93.78 (by fusion)..		....	....
F	93.48	2.00	95.48	0.39	0.40	2.19
G	93.01	.....	.....	0.38	....	1.80

The Concentration of Corundum

By Courtenay De Kalb

I BEG herewith to submit a report upon certain practical tests in the concentration of corundum rock, which have been made under my direction in the Kingston School of Mining. At the outset I wish to state that the work done has involved comparatively little original research, the problem being to ascertain how best to employ the customary methods of concentration in the production of high grade corundum concentrates. There exist some peculiar difficulties in determining the percentage of extraction obtainable under any conditions, since it is not feasible to definitely ascertain, by any simple direct test, either the amount of corundum in the original rock, or the quantity remaining in the tailings after concentration. Concerning the difficulties of estimation of the corundum by chemical analysis, the foregoing paper by Dr. W. L. Goodwin will afford explicit details. The specific gravity method gives results of comparatively small value (except after elimination of the magnetite), any effort to estimate the percentage of mixed barysomes in a given sample being futile for purposes of accurate work. The existence of magnetite (sp. g. 4 9 to 5.2) as an associate of the corundum (sp. g. 3.9 to 4.11), and the variation in the proportion of these minerals in the different sizes of the crushed rock, render it impossible to judge more than approximately from the specific gravity what amount of corundum may be present. The fact however that the proportion of magnetite to the corundum increases with considerable regularity with fineness of grade up to No. 150 mesh, gives to the specific gravities a certain value in comparing the different grades. The specific gravity of the whole ore appears to be about 2.9, although the determinations made range from 2.8 to 3.1. Calculating on the basis of an average specific gravity of 4 for the barysomes or heavy bodies, and of 2.68 for the gangue, we obtain 23.08 per cent. total barysomes (comprising the corundum and the magnetite only) in the rock. This result is approximately in accord with the percentage arrived at by mechanical concentration, the total concentrates in Test A being 18.987 per cent. and in Test B 22.63 per cent. of the rock treated, it being estimated that the concentrates in Test A contain 87.56 per cent. of corundum and magnetite, or 16.60 per cent. of the total rock treated, and that those in Test B contain 89.23 per cent. of corundum and magnetite, or 20.14 per cent. of the total rock treated. Considering that there has inevitably been some loss in the tailings, it would seem that the calculated percentage of total barysomes, although probably somewhat too high, is somewhere near the truth, which would give about 18.44 per cent. of corundum in the rock. This, it must be borne in mind, is only an approximate estimate. It has been proved however by Test A that it is possible to recover corundum to the extent of 12.74 per cent. of the rock treated, and by Test B to the extent of 15.50 per cent. Taking the maximum extraction, this would indicate a loss of 15.94 per cent. of the total corundum in the concentration. On the other hand the average specific gravity of the tailings in Test A is 2.742, which would show, on the same basis for calculation, only 0.756 per cent. barysomes lost. In Test B the average specific gravity of the tailings is 2.726, equivalent to 0.514 per cent. barysomes lost. It should be stated that the figure 2.68 for the specific gravity of barren tailings was arrived at by taking the average of the leanest tailings obtained in actual concentration. Since

Specific gravity method for determining grade of corundum rock.

the bulk of the gangue is orthoclase felspar, with considerable white felspar and nepheline, and less quantities of basic silicates, this result appears rational. Furthermore, careful examination of the tailings with a magnifying glass revealed an insignificant number of grains of corundum, save in some of the tailings from the buddle.

The percentage of corundum in the rock treated in Test A, as near as can be estimated, is 12.74 per cent., and in the rock treated in Test B it is 15.50 per cent. The lots of corundum rock upon which these determinations were made came from Carlow township in Hastings county. The specific gravity method was used in making these estimates, but, after elimination of the magnetite, this method can be relied upon to give nearly accurate results, consistent among themselves, and checking up closely with the results obtained by chemical analysis.

The Lines of Treatment

The crushing tests show that the corundum rock offers no peculiar difficulties in this respect. From plates I, II and III it appears that the crushing curve is perfectly normal, and in plate I it is shown that the curve is elevated, with no excessive production of fines, by successive crushing to smaller sizes. It was found that in order to liberate a sufficient quantity of corundum grains sufficiently free from gangue to admit of economical clean concentration it was necessary to crush to No. 8 mesh size (=0.0955 inch diameter). But the specific gravity curve (plate II) shows that the barysomes resist crushing so much more persistently than the gangue that it would appear to be desirable to crush no finer than ⅜-inch for a preliminary rough jigging. An attempt has been made to obtain distribution curves of the corundum and magnetite corresponding to the various sizes (plate II), which is approximately correct for the magnetite, but evidently in error for the corundum, owing to the difficulties with the specific gravity method already explained. The magnetite, being carefully separated from each grade by the magnet, was not involved in the same uncertainty.

Distribution curves in crushing tests of corundum and magnetic.

The corundum has a tendency to break in the form of tabular plates, so that a considerable percentage of the grains, notably in the larger sizes, have one diameter less than that aimed at in crushing. This peculiarity was particularly marked in the corundum rock from Renfrew county, Brudenell township. This tendency fortunately is much less in the finer sizes. The crushing curve of the Brudenell rock is shown in plate III. No further tests have so far been made upon this sample.

It need hardly be pointed out that any machine crushing by grinding or shearing would be wholly unsuited to the comminution of the corundum rock, the wear and tear upon the machine itself being sufficiently prohibitive without taking into consideration the undesirableness of the resultant product for concentration. Some form of jaw or gyratory crusher for coarse breaking, and high speed rolls with chrome steel or manganese steel tires for finer crushing, are the proper appliances.

Practical Concentration.

The specific gravity curve (plate II) shows the desirability of separating the coarse from the fine product in order to derive the high grade concentrates with a minimum of labor from the coarser sizes. These concentrates moreover will contain a minimum quantity of magnetite. This separation was carried out both in Test A and Test B. In the former the rock was crushed to ¼-inch before concentration was begun. In the latter, after crushing to ⅜-inch, it was screened over a 20 mesh sloping screen. It would have been far better to have screened it through a trommel, using a No. 8 mesh wire cloth, but a trommel was not available for the purpose. The results were so much better in Test B that the advantage of the method therein pursued is obvious, so far as the obtaining of a high grade of concentrates is concerned.

To obtain high grade concentrates.

The line of treatment followed in the two tests is better shown in the accompanying charts (plates IV and V) than would be possible by a detailed description. The machines employed were the common Hartz eccentric jig, the Frue vanner,

Machines employed.

the vertical line separator (an improved form of spitzlutte), a fixed buddle, and a Wetherill magnetic concentrator.

Appliances used in Test A.

In Test A the appliance chiefly used for high class work was the vertical line separator. Plate VI demonstrates to some extent its possibilities, but it is evident that much better work could have been obtained with it. The difficulty of judging by the eye as to the cleanness of the concentrates led to errors which could only be revealed by the subsequent determination of the specific gravities of the products. The fact that on one grade, containing material between No. 12 and No. 16 mesh, a product was obtained carrying 98.40 per cent. corundum after elimination of the magnetite, with corresponding tailings having a specific gravity of 2.816, is evidence of the possibility of securing rich concentrates with this simple and inexpensive appliance. The results are more clearly shown in tabular form:

Product.	lb.	sp. g.	Per cent. corundum after removing magnetite.
Tailings	43.456	2 816	.....
Spigot discharge.	5.0625	3.864	98 40

Resort was had to the jig however for the treatment of one grade of material in Test A, in which its higher efficiency stands out prominently, as shown below:

Product.	lb.	sp. g.	Per cent. Corundum after removing Magnetite.
Hutchwork, high grade concentrates.....	22.625	4.000	98.08
Screen discharge, high grade concentrates	15.750	3.663	87.80
Ragging, low grade concentrates	25.3125	2.809	21.41
Tailings, barren	131.258	2.695	.....

The vertical line separator was employed in Test A upon six grades of stuff, the average ratio of concentrates to tailings being as 1: 5.89. The average specific gravity of the concentrates (including magnetite) was 3.557, and of the tailings 2.703. A comparison with the jig is not possible in this respect, since the ragging is not a finished product, but it will be observed that the specific gravity of the jig tailings is 2.695, appreciably lower than that of the tailings from the vertical line separator. The vertical line separator was used on three grades of material in Test B from necessity, since the quantities of the intermediate products on which it was employed were too small for treatment on the jig. There is no doubt however that in practice similar products should be cleaned up on a fine jig, which would give a correspondingly higher grade of finished corundum concentrates. The average specific gravity of the concentrates (including magnetite) from the vertical line separator in Test B was 3.333, and of the tailings 2.783. The results, compared with those obtained with the jig, are shown in the table on next page.

The vertical line separator and the Hartz jig.

Inspection of this table will show how much more efficient the jig is for the work in hand, a result in entire conformity with what might have been anticipated.

Concentration by the Frue vanner and the buddle.

The work done by the Frue vanner was unsatisfactory. Better results could undoubtedly have been secured by classification of the material fed to it, but in any case its capacity would be too small to warrant its use. With the utmost care the best concentrates that could be obtained showed a specific gravity of only 3.4, with corresponding tailings having a specific gravity of 2.702. The concentration on the buddle in Test A gave concentrates with an average specific gravity of 3.699 and tailings with a specific gravity of 2.875. This is also unsatisfactory, but the material was unclassified, and contained a considerable percentage too coarse for this appliance. The buddle used, moreover, was far from perfect, and was capable of giving

sults of
ncentration
th vertical
e separator
d Hartz jig.

Appliance used.	Products.	lb.	sp. g.	Per cent. Corundum after removing Magnetite.
Vertical line separator.	Concentrates No. 12 mesh	21.969	3.350	75.08
	Tailings " 12 "	6.688	2.828	
	Concentrates " 16 "	18.75	3.436	69.12
	Tailings " 16 "	11.344	2.809	
	Concentrates " 20 "	5.25	3.533	73.38
	Tailings " 20 "	3.625	2.814	
	Concentrates " 24 "	3.625	3.571	83.20
	Tailings " 24 "	3.000	2.832	
	Concentrates " 30 "	3.698	3.571	73.37
	Tailings " 30 "	2.313	2.777	
	Concentrates " 40 "	2.724	3.521	67.41
	Tailings " 40 "	1.875	2.824	
	Concentrates " 24 "	5.000	2.904	82.75[30]
	Tailings " 24 "	4.000	2.754	
	Concentrates " 30 "	23.000	2.816	77.64
	Tailings " 30 "	22.000	2.777	
	Concentrates " 40 "	1.906	3.125	42.70
	Tailings " 40 "	36.000	2.749	
	Concentrates " 12 "	2.375	3.205	53.78
	Tailings " 12 "	0.844	2.777	
	Concentrates " 16 "	12.625	3.289	60.68
	Tailings " 16 "	7.000	2.801	
	Concentrates " 20 "	6.813	3.533	75.08
	Tailings " 20 "	5.000	2.762	
	Concentrates " 24 "	7.000	3.703	75.93
	Tailings " 24 "	5.500	2.762	
	Concentrates " 30 "	7.094	3.773	77.64
	Tailings " 30 "	5.875	2.762	
	Concentrates " 40 "	6.594	3.876	75.08
	Tailings " 40 "	5.813	2.816	
	Average of all concentrates	129.923	3.333	62.31
	Average of all tailings	127.765	2.783	
Hartz jig...	Hutchwork (rough jigging)	244.	3.410	
	Ragging "	300.	2.857	
	Tailings "	265.	2.684	
	Hutchwork (1st middle jigging)	13.	4.026	97.23
	Screen discharge "	63.5	4.053	93.82
	Ragging "	102.	3.144	
	Tailings "	51.5	2.737	Sized after concentration.[31] a. 77.19% 1.86 lb. b. 100.00% 2.125 " c. 96.38% 1.219 " Emery 3.68 "
	Hutchwork (2nd middle jigging)	15.	4.048	
	Screen discharge "	18.5	3.759	90.42
	Ragging "	26.	2.958	
	Tailings "	140.	2.688	Sized after concentration. a. 98.08% 7.625 lb. b. 80.19% 2.875 " Emery 1.39 "
	Hutchwork (3rd middle jigging)	23.	4.083	
	Screen discharge "	40.	3.610	89.51
	Ragging "	35.	2.941	
	Tailings "	277.	2.713	
	Average of all concentrates, including ragging	880.	3.257	
	Average of all tailings	733.5	2.699	

[30] This case may seem anomalous It is however n instance in which magnetite was adherent to lspar grains, causing them to follow the corunum grains in concentration. These being elimited by the magnetic separator leave a residual rundum of high enrichment.

[31] Lack of correspondence between the weights of the original concentrates and the residual corundum is due to decrease from elimination of the magnetite after concentration.

only two products, heads and tailings. Considering these disadvantages its work appears less discreditable, and shows that under proper conditions it would yield high grade concentrates.

Mica and Magnetite.

Treatment to eliminate mica and magnetite.

The treatment of any slimes from this corundum rock is complicated by the presence of large quantities of white mica (muscovite). Since the corundum has a tendency to break in a more or less tabular form, its separation from the mica is exceedingly difficult. The magnetite, on the other hand, breaks into grains of average shape, which for purposes of concentration may be regarded as approximately spherical. Hence it is evident that, in the treatment of these slimes on any form of contact-surface concentrator, an appliance should be used which will give heads, middlings and tailings. The heads would then be practically free from mica, and would contain the bulk of the magnetite and the more nearly rounded grains of corundum. The resultant corundum would be a superior abrasive. The middlings would require further treatment, and would produce a grade of corundum which should probably be further comminuted and separated into fine grades by blowing into a dust tower. The proper appliances then would manifestly be the sidebump table (improved Rittinger percussion table) and the buddle, using the spitzkasten for previous classification of the slimes.

The Wetherill Magnetic Concentrator.

The Wetherill magnetic concentrator has proven of the highest possible value in eliminating the magnetic material from the concentrates. It is capable of exceedingly delicate adjustment, and yet mechanically is of extreme simplicity. It has the advantage of lifting the magnetic particles clear of the non-magnetic, so that the formation of "nests," with the consequent inclusion of non-magnetic particles with the magnetic heads, is avoided. The only loss of corundum in the magnetic heads was due to the adherence of some magnetite to corundum grains. In the finer grades however it was found necessary to resort to sizing, in order to insure a corundum product free from magnetite. A feature of peculiar importance in this machine is that by varying the amperage a neat separation may be effected between iron-bearing minerals of widely different degrees of magnetic attractability. The practical application of this feature in cleaning up the corundum concentrates occurs in the finishing treatment of the highest grade material. The concentrates are first passed through the Wetherill magnetic separator with the current adjusted to 0.9 ampère. This eliminates all the magnetite. The non-magnetic residue containing the corundum is then again passed through the Wetherill machine, using a current of higher amperage. In our experiments 15 to 16 ampéres were found to be sufficient. The magnetic product in this case consists of

Table showing enrichment of corundum concentrates by elimination of gangue adherent to magnetite.

Products.	Concentrator used.	Diameter of grains, in.	Specific gravity.
Original concentrates	Hartz jig	.0955 to .0148	3.610
Non-magnetic portion		.0955 to .0148	3.724
Magnetic portion		.0955 to 0148	3.584
Original concentrates	Vertical line separator	.073 to .0583	3.350
Non-magnetic portion		.073 to .0583	3.508
Magnetic portion		.073 to .0583	3.257
Original concentrates	Vertical line separator	.0583 to .042	3.424
Non-magnetic portion		.0583 to .042	3.436
Magnetic portion		.0583 to .042	3.360
Original concentrates	Vertical line separator	.073 to .0583	3.205
Non-magnetic portion		.073 to .0583	3.223
Magnetic portion		.073 to .0583	3.174
Original concentrates	Vertical line separator	.0583 to .042	3.289
Non-magnetic portion		.0583 to .042	3.311
Magnetic portion		.0583 to .042	3.174

corundum containing small percentages of iron, associated with some very basic silicates. This product is practically an emery of rather superior grade, and is valuable as an inferior abrasive. The residual corundum after this final treatment is of great purity containing according to analyses by Dr. W. L. Goodwin about 0.38 per cent. of ferric oxide.

Purity of the Concentrates.

The increase in the purity of the final corundum concentrates by the elimination of gangue adherent to magnetite is shown in the table on page 244.

Table showing effect of fineness of size upon grade of magnetite eliminated.

Products.	Concentrator used.	Diameter of grains, in.	Specific gravity.
Original concentrates	Vertical line separator .	.073 to .0583	3.205
Non-magnetic portion....		.073 to .0583	3.223
Magnetic portion		.073 to .0583	3.174
Original concentrates	Vertical line separator.	.0583 to .042	3.289
Non-magnetic portion....		.0583 to .042	3.311
Magnetic portion.....		.0583 to .042	3.174
Original concentrates	Vertical line separator.	.042 to .0335	3.533
Non-magnetic portion....		.042 to .0335	3.508
Magnetic portion		.042 to .0335	3.633
Original concentrates	Vertical line separator .	.0335 to .0278	3.703
Non-magnetic portion....		.0335 to .0278	3.521
Magnetic portion		.0335 to .0278	4.000
Original concentrates	Vertical line separator.	.0279 to .0211	3.773
Non-magnetic portion....		.0279 to .0211	3.546
Magnetic portion.....		.0279 to .0211	4.273
Original concentrates	Vertical line separrtor .	.0211 to .0148	3.876
Non-magnetic portion....		.0211 to .0148	3.508
Magnetic portion.....		.0211 to .0148	4.762
Original concentrates	Buddle.....	.0148 to finest slimes....	3.703
Non-magnetic portion....		.0148 "	3.389
Magnetic portion....		.0148 "	5.076
Original concentrates	Vertical line separator .	.073 to .0583	3.350
Non-magnetic portion....		.073 to .0583	3.508
Magnetic portion.....		.073 to .0583	3.257
Original concentrates	Vertical line separator.	.0583 to .042	3.424
Non-magnetic portion....		.0583 to .042	3.436
Magnetic portion.....		.0583 to .042	3.360
Original concentrates	Vertical line separator.	.042 to .0335	3.533
Non-magnetic portion....		.042 to .0335	3.484
Magnetic portion.....		.042 to .0335	3.571
Original concentrates	Vertical line separator.	.0335 to .0279	3.636
Non-magnetic portion....		.0335 to .0279	3.571
Magnetic portion		.0335 to .0279	3.956
Original concentrates	Vertical line separator.	.0279 to .0211	3.571
Non-magnetic portion....		0279 to .0211	3.484
Magnetic portion.....		.0279 to .0211	3.731
Original concentrates	Vertical line separator .	.0211 to .0148	3.521
Non-magnetic portion....		.0211 to .0148	3.401
Magnetic portion		.0211 to .0148	4.545
Original concentrates	Buddle	.0148 to finest slimes....	3.921
Non-magnetic portion....		.0148 "	3.663
Magnetic portion		.0148 "	5.025

It is evident that the elimination of a pu magnetite requires reduction of the mater to grains having a maximum diameter

about .01475 in. (No. 40 mesh), the increase in the specific gravity of the magnetic heads conforming quite closely to the decrease in the diameter of the particles up to this point, where in the majority of cases the specific gravity was approximately that of pure magnetite. The magnetic heads from the finer sizes were perfectly black, revealing no adherent quartz or felspar, although there is in some of these products a very small quantity of adherent basic silicates, which are apparently the cause of the lower specific gravity in those instances. (See table on p. 246). The magnetite should prove a valuable by-product, the amount present in the corundum rock being approximately 4.64 per cent. of the total. Analyses have shown that it contains 0.03 per cent. of sulphur, no trace even of phosphorus, and 69.09 per cent. of metallic iron.

Value of fine crushing.

The coarser sizes of magnetic heads eliminated by the magnetic separator require further crushing, after which they can be returned to one of the final concentrating processes, whereby the corundum they contain will be recovered, and the magnetite itself will be obtained with the finer sizes in a marketable condition. It has been found by our tests that the magnetic heads coarser than No. 40 mesh eliminated, carry with them 6.77 per cent. of corundum.

Treatment of the coarser sizes.

Test A in Brief.

The original lot of corundum rock taken was 550 lb. The total products recovered amounted to 517.9679 lb., the missing 32.0321 lb. being due mainly to samples abstracted, and partly to loss in manipulation. The products recovered are distributed as follows:

Products won in the test.

Clean corundum concentrates.	77.1009 lb.
Magnetic heads	20.0115 "
Emery	1.4350 "
Tailings	419.4205 "

Being a total of 517.9679 lb. The percentages are:

Clean corundum concentrates	14.885
Magnetic heads	3.825
Emery	0 277
Total concentrates	18.987
Tailings	81.013
Total corundum recovered from rock.	12.74

The grades of corundum concentrates in percentages are:

Above 95 per cent. pure	36.790
Between 85 and 90 per cent. pure	21.279
Between 80 and 85 per cent. pure	2 461
Below 80 per cent. pure	39 470

The average of all corundum concentrates shows them to contain 84.11 per cent. corundum.

The calculated loss of corundum and magnetite in tailings is 0.756 per cent. (sp. g. 2.742). On the basis of the average specific gravity of the original rock the loss would be 15.94 per cent., but this result is subject to far more likelihood of serious error than that obtained from the average specific gravity of the tailings, since this was reached by averaging a very large number of separate determinations. Furthermore, examination with a lens fails to reveal corundum in the tailings.[32]

Loss in the A test.

Test B in Brief.

The original lot of corundum rock taken was 1,250 lb. The total products recovered amounted to 1199.8438 lb., or say 1,200 lb., the loss being due to the same causes as those mentioned in test A. The products recovered are distributed as follows:

Products won in the test.

Clean corundum concentrates	201.60 lb.
Magnetic heads	64 93 "
Emery	5 07 "
Tailings	928.40 "

Being a total of 1200 lb. The percentages are:

Clean corundum concentrates	16.80
Magnetic heads	5.4075
Emery	0.4225
Total concentrates	23.63
Tailings	77.37
Total corundum recovered from rock	16.50

The grades of corundum concentrates in percentages are:

Above 95 per cent. pure	14.76
Between 90 and 95 per cent. pure	37.06
Between 85 and 90 per cent. pure	18.71
Between 80 and 85 per cent. pure	3.14
Between 75 and 80 per cent. pure	9.74
Below 75 per cent. pure	16.59

[32] In a mineralogical examination of the tailings, made by Prof. William Nicol, of the School of Mining, a sample containing by actual count 3,234 separate grains, carried only 26 grains consisting wholly or in part of corundum.

The average of all corundum concentrates shows them to contain 90.08 per cent. corundum.

Loss in the test.

The loss of corundum and magnetite in tailings calculated from the specific gravity is 0.514 per cent. Calculated on the basis of the average specific gravity of the original rock, the loss would be 15.94 per cent., but the latter result is undoubtedly in far more serious error than the former, as previously stated.

Quality of the Corundum.

Physical tests necessary to prove value.

It is impossible to determine the quality of corundum for abrasive purposes by its appearance, or by chemical tests. For this purpose it is necessary to manufacture corundum wheels from the concentrates obtained, and subject these to various physical tests. This remains to be done and will then be made the subject of a later communication. Since many corundum wheels are made by a fritting or vitrifying process, the corundum being mixed with fusible clays, moulded, dried, dressed, and fired in kilns, the resistance of the corundum to alteration under the influence of long continued high temperature is of importance, and an effort was made to ascertain the quality of the Hastings corundum in this respect. It was impossible with the means at our command to make a satisfactory firing test, since the time of firing was too brief, but the results are given for what they may be worth. Thirty grams of selected corundum, specific gravity 3.91, were placed in a clay crucible, with cover tightly fitted inside the crucible mouth. This was placed inside a second crucible, with sand packing between the two, and with a cover tightly fitted inside the mouth of the outer crucible. This was put into a muffle, heated by gas, the temperature gradually raised for four hours, charcoal then being fed regularly into the muffle to raise the temperature nearly to white heat. This was continued for eight hours. The gas was then turned off, the muffle closed, and allowed to cool over night. The corundum was found to be slightly paler in color after this treatment, with a tendency to reveal the parting planes more clearly to the eye, but the hardness seemed to be unimpaired. The specific gravity of the fired corundum was found to be reduced to 3.846. Although by no means conclusive, this experiment raises a question as to whether this corundum will prove to be adapted for the manufacture of wheels by the fritting process, which can be proven most satisfactorily by a practical test, the firing being done under proper conditions in a kiln.

An Ore of Aluminum.

Requirements of the aluminium makers.

The market for corundum is not a large one, and it would not be difficult for extensive works to supply the world's demand. Hence any widening of the application of this mineral would be welcome. If it can be produced sufficiently pure, and subsequently reduced to a sufficiently fine state of subdivision, it could be used as an ore of aluminium. The standard required by the aluminium manufacturers is stated to be that the alumina shall contain not more than 0.10 per cent. silica and not more than 0.05 per cent. ferric oxide. Such alumina is ready for the reduction pots, and is worth at present about 4½ cents per pound at Pittsburgh, Pa., or at Niagara Falls, N.Y. The standard for raw alumina, previous to purification, requires that it shall contain not more than three per cent. silica nor more than two per cent. ferric oxide, but this is worth only $7 per ton, a price too low to admit of competition by corundum from deposits of no greater richness than 15 per cent. of that mineral.

The excessive refinement of portions of the process of treatment employed in our concentration tests on the corundum rock was in part for the purpose of producing, if possible, a grade of sufficient purity to meet the requirements of the aluminium makers. We succeeded in obtaining a product carrying over 99 per cent. of corundum. Analysis shows that this contains 0.4 per cent. silica and 0.39 per cent. ferric oxide. Grains of corundum selected from these high grade concentrates with the aid of a lens to insure freedom from adherent silicates showed 0.07 per cent. silica and 0.36 per cent. ferric oxide. From this result it would seem that if the standard of the aluminium manufacturers remains as it now is, the corundum

must undergo a process of purification before it can be offered in competition with purified bauxite. Whether such purification can be accomplished within commercial limits of cost, is a question still being investigated in our laboratories. Further efforts are also be ng made to obtain a purer quality of corundum by mechanical means. The reduction to a sufficiently fine powder, judging by some preliminary tests promises to offer no serious difficulty.

Preparation for Market

Production of various grades.

At the present time corundum users are content to obtain concentrates carrying about 80 per cent. of that mineral. By the application of ordinary concentration methods it has been shown that grades can be obtained which carry practically no impurities, except such as may exist in the corundum grains themselves. A modern concentration plant, under efficient management, following the lines suggested at the end of this paper, would produce no concentrates of lower grade than 80 per cent. It would accordingly be possible to obtain different qualities of concentrates from 80 per cent. to nearly pure corundum. As produced in concentration, these would vary in size from No. 4 mesh (=0.201-inch) to finest slimes. The finer sizes however would be less pure than some of the coarser and most of the intermediate sizes. These moreover would require exact sizing in order to be acceptable for the manufacture of corundum wheels and artificial oilstones. The coarser sizes as produced in concentration might require re-crushing after concentration, and thus the finer sizes of very pure corundum could be obtained. The dust should be drawn off by an exhauster and blower, the "flours" and grades known as "crocus" being obtained by deposition from the air current on shelves in a dust tower, in accordance with present practice in some corundum mills.

Schemes of Treatment.

Three schemes and their resulting products.

In a general way it may be indicated that in the treatment of rock similar to that experimented upon at the School of Mining any of the three following lines of treatment would give good results. The first could be relied upon to produce concentrates having on an average above 90 per cent. of corundum. The second would be slightly inferior to it, but is considerably more simple. The third is also a simple process, and should yield concentrates containing on an average 85 per cent. of corundum, or even more. It has been assumed in these schemes that the concentrates in the several hutches of each jig should be combined as one grade. This would be inadmissible if it were desired to produce one very clean grade of corundum for aluminium manufacture. It is questionable whether there would be a demand for such a pure-grade material as an abrasive at a price sufficiently high to warrant the complication of the treatment needed to obtain it. The methods herein suggested could be still further simplified and yet yield equally high grade or even higher average grade concentrates, but at the expense of a greater loss of corundum in the tailings. The question of the proper line of treatment is one that must be decided in each individual case, and will depend upon a multitude of economical considerations. The plans proposed accordingly are not intended to be taken as necessarily the best under the conditions that may arise where these corundum deposits may be worked. They are merely offered as outlines of methods, which, under sufficiently favorable conditions as to fuel and water supply, and as to transportation costs, could be counted upon to yield satisfactory results under competent mill superintendence.

SCHEME A.

1. Rock breaker. Product to No. 2 size.
2. Grizzly, ¾-inch.... a. Oversize: to 3. b. Undersize: to 4.
3. Rolls set to ¾-inch. to 4.
4. Trommel, 0.1 inch. c. Oversize: to 5. d. Undersize: to 10.
5. "Roughing" Jig. e. Hutchwork: to 6. f. Ragging: to 9. g. Tailings: waste.
6. Rolls for rich corundum, $\frac{1}{16}$-inch: to 7.
7. Single-spigot hydraulic classifier. h. Overflow: to 12. i. Spigot: to 8.
8. "Middling" Jig j. Hutchwork: to 17. k. Screen discharge: to 2!. l. Ragging: to 9. m. Tailings: waste.
9. Fine Rolls. To 10.
10. Single-spigot hydraulic classifier. n. Overflow: to 12 o. Spigot: to 11.
11. Jig ..... p. Hutchwork: to 17. q. Ragging: to 9. r. Tailings: waste.

12. Spitzkasten... { s. 1st compartment: to 11. / t. 2nd " to 13. / u. 3rd " to 15. / v. 4th " to 15. / w. Overflow: waste.
13. Percussion table .. { x. Heads: to 21. / y. Middlings: to 14. / z. Tailings: waste.
14. Finishing percussion table ..... { aa. Heads: to 24. / bb. Tailings: waste.
15. Buddle ..... { cc. Heads: to 21. / dd. Middlings: to 16. / ee. Tailings: waste.
16. Finishing buddle.. { ff. Heads: to 24. / gg. Tailings: waste.
17. Dryer: to 18.
18. Sizing screens: to 19.
19. Magnetic separator. 1 ampére. { hh. Magnetic heads: to 27. / ii. Corundum: to 20.
20. Magnetic separator. 16 ampéres. { jj. Emery. / kk. Corundum.
21. Dryer: to 22.
22. Sizing screens: to 23.
23. Magnetic separator. 1 ampère. { ll. Magnetic heads: to 27. / mm. Corundum.
24. Dryer: to 25.
25. Sizing screens: to 26.
26. Magnetic separator. 1 ampère. { nn. Magnetite. / oo. Corundum.
27. Magnetite rolls: to 28.
28. Spitzkasten. { pp. 1st compartment: to 14. / qq. 2nd " to 16. / rr. 3rd " waste. / ss. Overflow; "

SCHEME B.

1. Rock breaker. Product to No. 2 size.
2. Grizzly, ¾-inch. { a. Oversize: to 3. / b. Undersize: to 4.
3. Rolls, set to ¾-inch: to 4.
4. Trommel (series). { c. Oversize: to 5. / d. Middlings: to 7. / e. Fines: to 10.
5. "Roughing" jig. { f. Hutchwork: to 6. / g. Ragging: to 6. / h. Tailings: waste.
6. Rolls: to 7.
7. Screens or trommels. 5 sizes: products to 8.
8. Battery of vertical line separators. { i. Spigots: to 15. / j. Tailings: to 9.
9. Fine rolls: to 10.
10. Spitzkasten. { k. 1st compartment: to 11. / l. 2nd " to 12. / m. 3rd " to 13. / n. 4th " to 13. / o. Overflow: waste.
11. Jig. { p. Hutchwork: to 15. / q. Ragging: to 9. / r. Tailings: waste.
12. Jig. { s. Hutchwork: to 18. / t. Tailings: waste.
13. Buddle. { u. Heads: to 18. / v. Middlings: to 14. / w. Tailings: waste.
14. Finishing buddle. { x. Heads: to 18. / y. Tailings: waste.
15. Dryer: to 16.
16. Sizing screens: to 17.
17. Magnetic separator. { z. Magnetic heads: to 21. / aa. Corundum.
18. Dryer: to 19.
19. Sizing screens: to 20.
20. Magnetic separator. { bb. Magnetite. / cc. Corundum.
21. Magnetite rolls: to 22.
22. Spitzkasten. { dd. 1st compartment: to 12. / ee. 2nd " to 14. / ff. 3rd " to 14. / gg. Overflow: waste.

SCHEME C.

1. Rock breaker: product to No. 2 size.
2. Grizzly. { a. Oversize: to 3. / b. Undersize: to 5.
3. Rolls set out to 0.1-inch: to 4.
4. Trommel. { c. Oversize: back to 3. / d. Undersize: to 5.
5. Hydraulic classifier. { e. 1st Spigot: to 6. / f. 2nd " to 7. / g. 3rd " to 8. / h. 4th " to 8. / i. Overflow: to 10.
6. Jig. { j. Hutchwork: to 14. / k. Ragging: to 9. / l. Tailings: waste.
7. Jig. { m. Hutchwork: to 14. / n. Ragging: to 9. / o. Tailings: waste.
8. Jig. { p. Hutchwork: to 14. / q. Ragging: to 9. / r. Tailings: waste.
9. Fine rolls: to 10.
10. Spitzkasten. { s. 1st compartment: to 11. / t. 2nd " to 12. / u. 3rd " to 13. / v. 4th " to 13. / w. Overflow: waste.
11. Fine jig. { x. Hutchwork: to 17. / y. Tailings: waste.
12. Buddle. { z. Heads: to 17. / aa. Middlings: to 13. / bb. Tailings: waste.
13. Finishing buddle. { cc. Heads: to 17. / dd. Tailings: waste.
14. Dryer: to 15.
15. Sizing screens: to 16.
16. Magnetic separator. { ee. Magnetic heads: to 20. / ff. Corundum.
17. Dryer: to 18.
18. Sizing screens: to 19.
19. Magnetic separator. { gg. Magnetite. / hh. Corundum.
20. Magnetite rolls: to 10.

Production and Prices.

United States Statistics.

The production of corundum in the United States in 1897 is estimated by the Engineering and Mining Journal of New York as being 230 short tons, and of emery 1,500 tons. This applies to finished products, obtained for the most part, if not wholly, by washing by the so-called "mulling process." (See article on Corundum by C. N Jenks in Rothwell's Mineral Industry, vol. V, 1896, for description of this process.) The price of the corundum was $140 per ton, and of the emery $70 per ton. The output of American corundum and emery concentrates in 1895 and 1896 is shown below, as reported in Rothwell's Mineral Industry, vol. V.

All of the corundum used in America is of American production. The imports of emery into the United States for 1895 were, emery grains, 678,761 lb., $25,066; emery rock, 6,803 long tons, $80,386; manufactured emery, $27,586; total value, $133,038. In 1896 the imports were, grains, 755,693 lb., $28,493; rock, 6,389 long tons, $119,738; total value, $148,231.

Emery.

	1895.			1896.		
	Tons.	Value.	Price per ton.	Tons.	Value.	Price per ton
		$	$		$	$
Corundum	385	53,900	140	400	56,000	140
Emery	1,700	119,000	70	1,550	108,500	70

These are the latest quotations available from printed sources. It thus appears that the market price of corundum rules steady at seven cents per pound, and of emery at three and a half cents per pound. From the conditions under which the Hastings County corundum is found it may be stated that the cost of mining, on a sufficiently large scale, should apparently not exceed $1 per ton. The cost of milling should be considerable less than $1 per ton of the crude rock. Taking the average percentage found by practical concentration, viz., 14.67 per cent., this would yield 293.4 lb. of corundum per ton. It is evident that the corundum could be mined and milled at a cost so low as not only to compete easily with the present output of that article, but could compete successfully with emery, even if the price of emery should be reduced. To do this however preparations should be made to handle quantities of not less than 100 tons of rock daily. Small plants would work at a disadvantage that might lead to financial disaster. Practical tests of wheels made from this corundum, and a thorough investigation into the world's market must be made, as a preliminary to any consideration of operating mines and mills on the Ontario deposits. The tests of the manufactured product will be reported upon later.

Estimates of producing cost in the Ontario field

In conclusion I desire to commend the intelligence and zeal of my assistant, Mr. Charles G. Rothwell, to whose excellent work is due a very considerable part of the practical results of the tests made. I wish also to express my indebtedness to Mr. N. R. Carmichael, M.A., for valuable assistance in connection with the electrical work.

Water Powers of Ontario

By Thomas W. Gibson

IN speaking at Buffalo, N.Y., January 12, 1897, on the occasion of the introduction into that city of electric power from Niagara Falls, Mr. Nikola Tesla, perhaps the most celebrated of living electricians, spoke of a tremendous problem yet to be solved in the production of power, to the elucidation of which he had devoted a great deal of attention. Without describing the nature of this problem, he spoke of it as an effort to "evolve means for obtaining energy from stores which are forever inexhaustible, to perfect methods which do not imply consumption and waste of any material whatever." Even if this stupendous achievement were accomplished however, (as he had little doubt it would be), he said his investigations led him to conclude that "under the theoretically best conditions such a method of obtaining power cannot equal in economy, simplicity and many other features the present method involving a conversion of the mechanical energy of running water into electrical energy, and the transmission of the latter in the form of currents of very high tension to great distances. Provided therefore that we can avail ourselves of currents of sufficiently high tension, a waterfall affords us the most advantageous means of getting power from the sun sufficient for all our wants, and this recognition has impressed me strongly with the future importance of the water power, not so much of its commercial value, though it may be very great, but chiefly of its bearing upon our safety and welfare." [1]

The most advantageous means of getting power.

An Extensive Region favorable for Water Power.

If Mr. Tesla's conclusion be correct, namely, that a waterfall affords us the most advantageous means of getting power from the sun for all our wants, excelling for this purpose not only muscular force, but wind and steam as well, the rocky uplands of northern and western Ontario may yet be reckoned among the most valuable parts of the Province by reason of the vast number of waterfalls situated there. The main watershed dividing the system of the great lakes from that of Hudson bay runs in a northwesterly direction from the eastern boundary of the Province north of lake Temiscamingue to the head of lake St. Joseph on the northern boundary, a distance of about 500 miles. It consists of a tableland or plateau rather than a sharply defined ridge, and is estimated to have an average width of about 70 miles, or an area of about 35,000 square miles, thus with the slopes on both sides affording an extensive catchment surface for the streams running to the north and south. Its elevation will average perhaps 1,400 or 1,500 feet above the level of the sea, or 900 feet above lakes Huron and Superior. In places it approaches the shore of the latter lake, and for the greater part of its extent is situated at a comparatively short distance from either of these bodies of water. The consequence is that the rivers and streams which flow from it into the great lakes, though mostly of considerable volume, are not of great length, and their descent is therefore usually rapid and abrupt, and marked in many places by cascades and falls.

Waterfalls of Northern Ontario.

The value of a river of given volume for purposes of water power does not altogether, or even chiefly, depend upon the amount of its fall from source to mouth. Of course the greater the fall the greater the energy possessed by the stream as a whole. But it is apparent that if the descent be gradual and uniform, or approximately so, there will be few places in its course where the fall is large enough to afford any considerable quantity of power. It is only where sudden falls or rapids occur, which create a decided difference in the level of the water, that the energy of the river is concentrated, as it were, within a short space, and can be utilized. The nature of the soil or surface of the country through which the

Favorable circumstances of the region.

[1] Cassier's Magazine, March, 1897, p. 385.

river runs has an important effect in influencing the habit of the stream in this respect, and so determining its value as a producer of power. If it be composed of sand, clay, gravel, or even the softer and more easily decomposed rocks, it will usually be found that the river has worn its bed to a fairly uniform slope throughout, in which case there will be few opportunities of developing power from its waters. Even if a slight drop should occur, a dam would probably be required in order to obtain any considerable head, and the erection of dams, while often necessary and advantageous, involves additional expense both in construction and maintenance. In a river whose bed is composed of hard rock, such as is usually comprised in the Laurentian and Huronian formations of northern and western Ontario, the eroding force of the water meets with much greater resistance, and its course is more likely to be marked by abrupt changes of level in rapids and falls, and indeed this is characteristic of many if not most of the rivers in those parts of the Province. Another prominent feature of the topography of these districts is the very large number of lakes, varying in size from mere ponds to large and important sheets of water. These are either the sources of or tributary to the rivers, or expansions of them, and act as reservoirs or storage basins, tending to regulate the flow of the water and to render it constant and steady throughout the year.

The character of the country in northern and western Ontario is therefore such as to provide an almost illimitable amount of water power readily available. Taking into account the annual precipitation of moisture in the form of rain and snow, there is no reason to doubt that hundreds of thousands of horse power could be generated from the waters of streams flowing into the great lakes with a minimum of trouble and expense. A shorter watershed running from the main one southwesterly round the western end of lake Superior divides the streams falling into that lake from those which find their way into lake Winnipeg and so into Hudson bay, and the waters running in both directions from this divide furnish many fine water privileges, similar in character and equally available; while tributary to the Ottawa river, and in that part of the Province included within the boundaries of Algonquin National Park, as well as to the south and west, are numerous rivers of considerable fall and volume, from which a very large additional amount of power could with little difficulty be obtained. The streams flowing into Hudson bay, such as the Albany, Kenogami, Missinaibi, Mattagami and Abitibi are of greater average length than those running into the great lakes, and as they descend to the level of the sea, say 600 feet below that of lakes Superior and Huron, many falls are to be found upon them, particularly in their upper reaches and in the neighborhood of the "long portages," where their waters are interrupted by the hard rocks of the old formations on their way to the more level Devonian plains bordering on James bay. For the present however these rivers are too remote to be regarded as sources of available power, though the time may come when they will be called into requisition. But on the Seine, Atik-okan, Wabigoon, Winnipeg and Rainy rivers, on the Mattawin, Kaministiquia, Nipigon, Steel, Pic, Magpie and Michipicoton, on the Mississaga, Thessalon, Spanish, Vermilion, Wahnapitae and Sturgeon, on the Montreal, Ottawa, Petawawa, Bonnechere and Madawaska, on the Muskoka, Maganetawan and Severn, and on many others, there are numerous falls and rapids waiting to be utilized and capable of doing the work now being done by all the steam engines in Ontario a hundred or a thousand times over. This is leaving out of view the waterfalls already developed and in use in the older portions of the Province, as well as the stupendous energies of the falls of the St. Mary and Niagara rivers, which are already, one on the Canadian and the other on the American side, to some extent made use of.

Illimitable extent of available power.

Practical Uses of Power.

The rivers enumerated above are situated among the forests of pine and hardwood which cover so considerable a portion of New Ontario, and in many cases they are contiguous to valuable deposits of ore or mineral. The raw

Possible industries in Northern Ontario.

material for many industries lies around them. The sawmill, planing mill, sash and door factory, pulp mill, match factory and many other wood-working industries might happily combine abundant raw material and cheap power on these streams, while stamp mills and other mining plants might be worked with profit and success. Other industries, such as woollen, cotton and flour mills and chemical manufactories might avail themselves of the cheap power without necessarily locating in the immediate neighborhood of the waterfall, by connecting themselves with it by means of the electric current, though for textile, paper and other industries whose processes necessitate the use of large quantities of clear water, a waterfall convenient to means of transportation forms an ideal site. Electrically driven railways seem likely to come into vogue in this and other parts of the world because of their low first cost and inexpensive maintenance, and it appears feasible to operate electric roads by currents generated by the waterfalls on the rivers in many parts of the districts referred to. Such railways might serve a very useful purpose in carrying lumber, ore, raw and finished material and supplies of all kinds in a country where perhaps the volume of traffic might not be sufficient to render an ordinary steam railway a profitable undertaking.

Advantages of water power converted into electric energy.

Water power, whether employed directly to operate machinery, or converted into electric energy for the same purpose, has many advantages over the steam engine. For the same quantity of power, its first cost is not usually much greater, and often not so great, and once installed it requires little or no attention. Its danger to life and property is less. It needs no fuel, a consideration specially important in Ontario, which has no coal beds, and where in time even the present abundant supplies of wood will be exhausted. Hitherto the chief disadvantage of water power has been its immobility. If a waterfall was not conveniently situated, it was of little or no use. If it did not pay to place a manufactory along side a waterfall, the fall could not be brought to the factory. Now this has to a large extent been changed, and power can be delivered without serious waste many miles from where it is electrically produced. The change will be still more marked when the problem of transmitting electric energy through long distances has been thoroughly solved, and Nikola Tesla looks forward to a speedy solution.

The presence of so many available water powers in the Lake of the Woods, Seine River, Wahnapitae and other mining districts of Ontario is a fortunate circumstance, and cannot but have a very favorable effect upon their development. Cheap power means economy in working, and will permit of ore bodies being profitably utilized which would otherwise not pay for treatment. The immense deposits of low grade ore which are found north of lake Superior and on the Upper Seine are in many cases situated in proximity to waterfalls capable of yielding hundreds and thousands of horse power at comparatively little expense. The importance of preserving these water powers as far as possible for the general benefit and preventing their being locked up in the hands of speculative individuals who would not use them themselves, but who would demand heavy toll for their use by others, has led to the adoption of new regulations under the Act respecting Water Powers, (61 Vict., chap. 8) passed at the last session of the Legislature. The principal features of these regulations are those which provide for the leasing of such powers by the Crown, instead of patenting them outright, and for the furnishing of surplus power by the lessee to others on terms to be fixed in case of disagreement by the Lieutenant-Governor in Council. The full text of the Act, which was assented to January 17, 1898, and of the regulations, which were adopted by Order in Council dated June 21, 1898, is as follows:

An Act respecting Water Powers.

Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows: The Commissioner of Crown Lands may reserve from sale any water power or privilege on the Crown Lands of the Province, and a sufficient area of land

Reservation of water power on Crown Lands

in connection therewith for the erection of buildings and plant, together with the right to lay out and use such roads as may be necessary for passage to and from such water power or privilege and land, and may under regulations to be approved by the Lieutenant-Governor in Council make terms and conditions upon which such water power and land so reserved may be sold or leased, and developed.

REGULATIONS RE WATER POWERS.[1]

Rules and Regulations.

1. These rules and regulations shall not apply to water privileges which in their natural condition at the average low stage of water have not a greater capacity than 150 horse power.

2. In granting or leasing otherwise than under these regulations any Crown lands upon which a water privilege is situated, the said privilege shall be reserved to the Crown, together with such an area of land in connection therewith as shall in the opinion of the Commissioner of Crown Lands be required for the proper development of the same, and the construction of all necessary dams, weirs, tunnels, races, flumes, sluices, pits and other structures or works, and the erection of buildings and plant for the employment and utilization of such privilege, and storing grounds and yards in connection therewith; and there shall also be reserved in any such grant or lease the right to flood any portion of the lands so granted or leased upon compensation to be made to the owner or lessee thereof by the person or persons to whom such privilege shall afterwards be leased; and the said water privilege, land and right so reserved shall form a separate property to be dealt with as hereinafter provided.

3. The right to lay out and use such roads as may be necessary for the passage to and from such water privilege or land shall be reserved in all grants or leases of contiguous or adjoining lands.

4. The applicant for a water privilege situated on Crown lands shall, if necessary, file in the Department of Crown Lands a plan and field notes by an Ontario Land Surveyor of survey thereof; and also a statement setting out:

(a) The location of the water privilege applied for, and a description of the land required in connection therewith.

(b) The height of the fall or rapid, the volume of water at the average high and low stages of same, the estimated capacity in horse power of the fall or rapid in its natural condition at the average low stage of water, the height of the dams or weirs (if any) which it is proposed to construct, and the increase in the level of the water which such dams or weirs will bring about.

(c) The nature and location of the business, plant or manufactory in connection with which it is proposed by the applicant to utilize the water privilege, and the number of horse power which the applicant proposes to develop and use (1) within two years, (2) within five years.

(d) The plan by which the applicant proposes to develop the water privilege, showing the dams, weirs, tunnels, races, flumes, sluices, pits and other structures or works which it is proposed to build or make in connection therewith, the estimated cost thereof, and the form in which the power is to be used or transmitted, that is, whether by direct energy, electricity, compressed air, etc.

(e) The land or lands which would be overflowed or otherwise affected by the raising of the water or the construction of the dams, weirs, sluices, races or other works in connection with the development or use of such water privilege and the owner or owners thereof.

5. The Commissioner of Crown Lands shall have power to call for measurements, plans, specifications, descriptions, levels, profiles, elevations and all such other information as he may deem necessary for the proper consideration of the application, which shall be furnished at the applicant's expense. The plans and specifications for the construction of the necessary dams, weirs, tunnels, races, flumes, sluices, pits and other works for the development of such water privilege shall be submitted to the Commissioner of Crown Lands, if so required by him, and such works shall not be proceeded with until the Com-

[1] An Order in Council approved by His Honor the Lieutenant-Governor, the 21st day of June, A.D. 1898.

missioner has approved the said plans and specifications.

6. The applicant shall submit such proof of his financial standing and ability to develop the said water privilege as shall be satisfactory to the Commissioner of Crown Lands.

7. On approval by the Commissioner of Crown Lands of an application for a water privilege, he may order a lease of same to issue therefor, such lease to be for a term of ten years, with the right of renewal for a further term of ten years at the same rental, if the covenants and conditions have been performed and fulfilled, and thereafter with the further right of renewal for a term of twenty years upon such terms and conditions and at such rental as may then be provided by law or regulation.

8. The rental under any such lease shall be such sum as may be fixed by the Commissioner of Crown Lands, and shall be payable yearly in advance. Where application is made for the right to develop not more than half the maximum estimated capacity of a privilege at the average low stage of water as aforesaid, and where the granting of such application would not prevent or interfere with the development by other parties of the remaining capacity of the said privilege, the Commissioner may grant the same and may, if he think proper, reserve a portion of the land connected with the water privilege, provided that in any such case the Commissioner may issue a lease or leases for the remaining capacity of the said privilege, and the remaining lands connected therewith.

9. The right of timber owners and others to drive their logs down any river, stream or other body of water, as now by law established, shall not be interfered with, lessened or restricted by the granting of any such lease; and if any dam, weir or other structure be erected or built in connection with the development of any such privilege, with the object, intention or effect of damming the water or impeding the flow thereof, full and proper provision as now by law required shall be made by the lessee for the passage of logs and timber over and through the same.

10. The lessee under any such lease shall not destroy or obstruct the navigation of any river, stream or body of water previously navigable, but shall provide such locks, canals, passages and other means as may be necessary for the proper and safe surmounting or passing of any dam, weir or other work made or erected by the lessee.

11. The lease shall also provide—

(a) For the development and use within a period to be named in the lease of at least one-half the power proposed to be developed and used, and for the development and use of the full capacity of the privilege estimated as aforesaid, or of the remainder of the power proposed to be developed and used, as the case may be, within a further period to be named in the lease.

(b) For the use by other parties than the lessee of surplus or unused water or power not required by him for the purposes of his business, plant or manufactory on such terms as may be agreed upon; and failing an agreement between the parties as to the terms and conditions on which such surplus or unused water or power may be used, and the remuneration to be paid therefor, the Lieutenant Governor in Council shall have power to fix and determine the same, and any Order in Council fixing such terms, conditions and remuneration, shall be final and conclusive and binding upon all parties concerned.

(c) For the erection and maintenance by the lessee of a durable and efficient fishway when so required by the proper officer or authority in that behalf.

(d) Failure or refusal of the lessee to comply with the conditions of the lease, or default in payment of the yearly rental for ninety days after the same falls due, shall work a forfeiture of the lease.

(e) During the continuance of the lease, the lessee shall keep and maintain all dams, weirs, tunnels, races, flumes, sluices, pits and other structures and works necessary for the development and use of such privilege in good repair and condition, and shall not wilfully or otherwise injure or destroy the same or any part thereof, but at the expiry or sooner determination of the said lease, shall leave all such structures and works in good repair and condition, and so that their subsequent usefulness shall not be lessened by any act of the said lessee.

(f) At the expiry or sooner determination of the lease, the water privilege shall revert to and become the property of the Crown as fully as if no such lease had been granted, together with all dams, weirs, tunnels, races, flumes, sluices, pits and other structures or works made or erected by the lessee in connection therewith, and all buildings erected on land covered by the lease; but the lessee shall be allowed a reasonable time to be fixed by the Commissioner of Crown Lands in which to remove all machinery employed by him in the development and use of the privilege, failing which removal such machinery shall become the property of the Crown.

(g) Where there is more than one applicant for a water privilege the Commissioner of Crown Lands may, at his discretion, put the same up at public auction or tender, subject to the foregoing conditions, to be awarded to the highest bidder or tenderer for a lease thereunder.

(h) If at any time or times privilege has been developed, or to the extent to which the by the lease to develop the lessee shall continuously negl of one year effectually to from the said privilege, eitl use or for that of other hindered by unavoidable acci tenant-Governor in Council direct the said lease to be fo celled.

12. Where a water privileg by a municipal corporation fo supplying water, power, light use of the inhabitants thereo sioner of Crown Lands may said privilege to such corporat entitled to receive and hold such special terms and condit rental as he may deem proper

Placer Gold on Vermilion Riv

By Arthur H. Gracey

IN obedience to the instructions received from the Director of the Bureau of Mines on the 18th of May, I left Gananoque on the 19th to examine the reported finds of placer gold along the Vermilion river in the surveyed townships of Wisner, Capreol, Norman and Hanmer, and in the unsurveyed territory lying north and west of these townships.

I proceeded to Wahnapitae station on the Canadian Pacific Railway, where I was joined by Mr. Charles Henderson, forest ranger, who accompanied me on the trip. A couple of days were occupied in making arrangements, and on Monday, the 23rd, we left for Wahnapitae lake, lying northeast of Sudbury. I heard that gold had been found on Massey creek, which flows into the bay of the same name at the southern end of the lake On Tuesday I went over to the creek and found about half a mile from its mouth four men working with a rocker. They had put in a small wingdam, thereby diverting a portion of the stream from its regular channel, and were washing the gravel from the bed of that portion. They were using mercury in the riffles of the rocker, and I could not tell was any gold in it or not, bu the appearance of the mer little or none. I also pann gravel they were rocking, but

On Wahnapitae lake and Massey bay.

There are some extensive around Massey bay, rising fr above the water line, but I f any of them.

On Vermilion Ri

On Wednesday, the 25th, lake to Skynner's bay on tl Wahnapitae lake, chain of three smal portages form a with the Vermilion river. latter that night, opposite an Marshy lake, in the north Capreol. On the east shor numerous holes had been s bed of some extent. I found and near the surface a couple pan. In two holes sunk to a and 12 feet farther inland, traces of gold. I also exami

Marshy lake on Vermilion river.

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creeks entering near this point, but found no favorable indications.

From Marshy lake we moved up stream to a point called Dacey's camp, in the northeast corner of Hanmer. At this place the first discovery of gold is reported to have been made last fall. On both sides of the river there are large beds of gravel, carrying gold in varying quantities. Opposite the camp on the east bank of the river I found traces of gold in the grass roots, and from a hole about three feet deep. On the ridge about 150 yards from the river, and probably 15 feet higher, I got over 30 colors to the pan, but they were quite fine.

Dacey's Camp.

Before proceeding further it may be as well to explain for the benefit of those not accustomed to mining phrases what is meant by the words 'color' and 'trace,' and about what value per ton or cubic yard of gravel a certain number of colors would indicate. A small particle of gold visible to the naked eye, or under the ordinary magnifying glass, is called a color; consequently, if after washing a pan of gravel five or six particles or specks of gold are seen, they are spoken of as colors. The term trace of gold is used more particularly in connection with assaying, and means that there is gold, but in such small quantities as to make an estimate of value per ton difficult. A cubic yard of dry gravel will weigh about 2,900 pounds. From 12 to 14 cubic feet of tightly cemented, or about 18½ cubic feet of loose gravel, will weigh a ton. An average pan of gravel will weigh from 20 to 30 pounds, according to moisture. There are about 132 average panfuls in a cubic yard.

Color and trace.

As an example of value per ton or cubic yard, I got from a panful of this Vermilion gravel 34 colors visible to the naked eye, but which showed under the microscope altogether 44 colors. The combined weight of these colors was 1.3 milligrams, which, taking the weight of the gravel in the pan at 20 pounds, would give a value of about eight cents per ton, or about 12 cents per cubic yard, taking the gold at $20 per ounce, which is more than it would be worth. These were average colors; the largest weighed .5 milligram and the smallest, as mentioned, was invisible to the naked eye.

Above Dacey's camp we passed numerous beds of gravel in which prospect holes had been sunk, but only few to a greater depth than three or four feet. Pannings from the majority of these showed little or no gold. At one or two places, some two or three hundred yards from the river, I found a color or two in nearly every pan. This was just below Ross lake. Lying about half a mile east of Ross lake is another small lake, the ridge between being all gravel and carrying gold. There was a party of prospectors camped on this ridge, but little development work had been done. Several holes had been sunk to depths of from eight to 12 feet, and there was water in the bottoms of most of them. There was little variation in the value of the gravel from the surface to the depth reached. It would average from 15 to 30 colors to the pan. One pan from this place contained 105 colors, I was told. This deposit extends for some distance in a northerly and southerly direction. On the west side of Ross lake there had been some prospecting done also; one hole about 12 feet deep was on the bank of a creek about a quarter of a mile inland from the lake, and showed traces of gold. The next expansion of any consequence was Fraser lake. A creek enters from the west, and at the junction I found somewhat coarser gold than the average of that below, running from three to five colors to the pan.

Prospecting near Ross lake

Along the banks of the next lake there have been several claims taken up and several shallow holes sunk. A short distance from the east bank of this lake high bluffs of Huronian rocks rise, and the strip of gravel between their base and the shore carries gold averaging from seven to 12 colors to the pan. Sault Ste. Marie parties have taken up some claims here and above, and they informed me that they intended making preparations to sink to bed-rock. One hole in this vicinity, sunk to a depth of 10 feet, passed through about three feet of soil, then two feet of gravel carrying from 10 to 12 colors to the pan. Below the gravel was a layer of sand, and below that again a sort of hardpan. Neither in the sand or next the hardpan was there any gold.

On the banks of Gibson lake, the next of consequence, were several locations. One on

the west side, where a small creek enters, covers some favorable looking gravel, and pannings from the surface to a depth of five feet showed on the average about 15 colors. There is a good opportunity for the owners of this claim to do development work, as the creek would furnish them with a fair head of water. At the head of Gibson lake is a deposit of fine sand carrying traces of gold. Above Gibson lake deposits of gravel are scattered along as shown on the accompanying map. The greater part of it has been claimed, but, with the exception of a few shallow holes, no work has been done. At many points my samples contained no gold, but when they did it was about the usual amount, a few fine colors.

Locations around and above Gibson lake.

Around the old Hudson's Bay post, on what we called Post lake, there is a large area of gravel, and samples taken from the bank showed coarser gold than was found lower down stream, but no increase in quantity. About 20 acres surrounding the Post are cleared ; the balance of the country for some miles west was covered by green pine. There is a creek from the west entering the next lake above Post lake, which passes through gravel for about three miles. A party of prospectors was camped on it, near the lake. They had a cut opened up on one of the bars of this creek about 15 feet long and four feet deep. The gravel was somewhat cemented, and carried coarser gold than any I had hitherto found. The owners purpose working up the creek with a bed-rock sluice, which would prospect he deposit very well.

Showings at the old H. B. Company's ost.

Above this point to the headwaters of tha Vermilion we did not notice so many discovery posts, although most of the land has been taken up in large tracts. Gold is found in the surface gravel in many places, but I noticed little difference from the average of that down stream.

Wahnapitae River and Onaping Lake.

From the headwaters of the Vermilion we portaged into Wahnapitae waters. The latter river encircles the head of the former to the northwest. The gravel beds continue about the same, and down the Wahnapitae a couple of miles from where it leaves Islet lake I sunk a hole through about three feet of sand, then came into gravel carrying a few fine colors to the pan. In another hole half a mile farther up stream, which was about six feet deep, the gravel showed at the surface from 10 to 15 colors to the pan, and below the gravel was a streak of fine sand lying on the bed-rock which carried no gold.

Exploring the Upper Wahnapitae river.

Although we met a large number of prospectors scattered along the river we found no one doing any actual prospecting or development work, and of course no "dust" was being taken out. The rush appeared to be to secure locations. No one, so far as I heard or found, had reached bed-rock on the Vermilion, and to do so in many of the beds would be an expensive operation, as it is no doubt in many places far below the surface, possibly 100 feet or more at some points. Water would be encountered at moderate depths, and the gravel would require careful timbering. There is an extensive territory in the Vermilion and Wahnapitae basins (and possibly extending west to lake Onaping, as I found traces of gold on the banks of that lake)containing large deposits of auriferous gravel. Little of the gravel sampled along the route would go more than from 12 to 15 cents per cubic yard; the average was much less, although pans have been washed that would indicate a value of from 50 cents to $1 per cubic yard.

Extent and depth of the gravel beds.

General Conclusions.

In California ground has been worked at a profit by improved hydraulic methods which yielded only three cents per ton, and in British Colum ia gravel is handled at a profit which yields 16½ cents per cubic yard. This method could not be used on the Vermilion to any extent, first because there is not sufficient fall to get a strong head of water, and secondly there would be no dumping ground for any quantity of tailings. With the improved chain bucket dredge, gravel has been handled at a cost of from three to five cents per cubic yard. A dredge of this type is calculated to handle from 60 to 100 cubic yards per hour, and requires only enough water to float it and wash the gravel. One of these in operation

Placer workings in California.

in the Western States was recently visited by the writer. The machinery, consisting of a large boiler, engine, pumps, donkey engines, etc., was compactly placed on a flat bottomed barge or scow. The elevator buckets were attached to an endless chain ladder which passed over revolving drums or cylinders at the upper and lower ends of the carrying frame, the principle being the same as a grain elevator in a flour mill. This frame could be lowered so that the buckets would take gravel from any depth less than 50 or 60 feet below water. At the top the gravel was dumped into a large hopper into which also about 400 miner's inches of water was flowing from a Chinese pump. From the hopper the gravel was washed into the sluices, two in number, which, elevated above the machinery, ran parallel from the forward end back far enough to clear the stern. These sluices had a fall of about one inch to the foot. Raised a few inches above their bottoms and running their entire length was a system of iron screens. Each screen was about three feet long and arranged with a slight drop from one to the other. All the coarse gravel, etc., was carried over on top of these screens, while the fine stuff containing the gold passed through on to burlap and Canton flannel which lined the bottoms. The gold was caught in the fibres of the burlap and flannel, whence it was recovered when cleaning up by careful washing in a vat or tub. These washings of course contained a large amount of black sand, and they were afterwards carefully passed over amalgamated plates to separate the gold. This plant was handling about 100 cubic yards of gravel per hour, and was being operated at an expense of less than $75 per day of 24 hours.

The deposits on the Vermilion river show water action, and necessarily of a much larger body than that now existing. The coarsest of the gold under the microscope appears mostly in thin plates and flakes with rounded edges, while the finer colors are more "shotty" in form.

To estimate the probable value of these placers would be impossible until more actual development work has been done. They are not "poor men's diggings" so far as can be judged at present and whether they will improve in value as bed-rock is approached, which in a general sense is the case with placer diggings, remains to be seen.

My examinations were necessarily superficial. To make them more extended would require considerable time, with a chance to do more work of a practical nature.

Mining Schools and Classes

Kingston School of Mining

The following report on the work of the Kingston School of Mining is made to the Bureau under date of June 25, 1898, by the Director of the School:

Fifth Session of the School.

In presenting to you my report of the fifth session of the School of Mining, I have in the first place to note a considerable increase in the number of students who have attended classes in the School. The number taking a full course in Mining Engineering has increased from 13 for the session 1896-97 to 30 for the session just closed. The total number of students registered was 191; for the session 1896-97 it was 172. The Prospectors' course was attended by 25, several of whom remained until the close of the regular session. Two of these have entered upon a degree course. In both the Prospectors' class and the class studying for a degree in Mining there are men from nearly every Province of the Dominion, including British Columbia and Nova Scotia. I add a classified statement of the numbers of students:

Mining Engineering (Degree Courses)	30
Mining Engineering (Prospectors' Courses)	25
Other Engineering Courses	6
Veterinary Medicine	3
Other Courses	129
	193
Deduct, counted twice	2
Total number registered	191

Outside Classes.

Outside classes were conducted last summer by myself and Mr. F. J. Pope in Bancroft, Marmora and Madoc, and were attended by 109 students, many of whom, as is usual with these classes, could be present only occasionally. No attempt was made to give theoretical instruction, except a few essential working ideas in Mineralogy and Geology. The greater part of the time was spent in examining rocks and minerals, in testing their properties, and in assaying samples for gold and silver. Instruction was also given in sampling and in the use of the miner's pan. Several prospects were visited at the request of the owners, and attention was directed to the possible discovery of tinstone, corundum, and other valuable minerals not being then searched for by prospectors in that district. The number of students in attendance were: At Bancroft, 41; at Madoc, 33; and at Marmora, 35. The Bureau of Mines collection at Marmora excited much interest, and was found very useful for instruction purposes. These collections, now installed in five mining centres in the Province, were suggested by Mr. Hamilton Merritt, and prepared in the School of Mining. Their usefulness amply justifies both Mr. Merritt's foresight and the expenditure incurred by the Government.

Schools in the Eastern part of the Province.

Mr. Hamilton Merritt held classes in the western part of the Province, and reports as follows:

'The desire for prospectors' classes during the winter or early spring has been expressed more than once, and particularly in the Rat Portage petition. It was urged, with reason, that more time could then be given to this kind of work, before the rush of summer business came on. The experiment of holding four prospectors' classes in western Ontario during the winter and spring of the present year was therefore made, and while the attendance was on the whole not larger than the previous occasion on which classes were held in the west, it was much more regular. The classes at Rat Portage and Sault Ste. Marie were decidedly larger, Sudbury was about the same, and Port Arthur was a smaller class owing to Fort William men not co-operating as formerly.

Schools in the western part of the Province.

'The classes were held at Rat Portage January 24-February 4, Port Arthur February 7-19, Sudbury March 21-31, and Sault Ste. Marie April 6-16. At these four towns the Government collections of minerals and rocks had been placed. These collections were originally suggested by myself, largely in the hope that they would become the nuclei of good local collections. This desirable object has not yet been carried out at any of the above mentioned places, but it is receiving consideration, and a commencement has been made. The collections proved most useful for the purposes of instruction, and no doubt will be occasionally referred to for comparison of samples of ore and rock.

Mineral collections.

'The work of the classes was on somewhat similar lines to those previously adopted by me for giving prospectors practical instruction. Advanced character of work was undertaken by some of the students who had previously attended my class, and in one instance some very creditable apparatus had been made as a result of my previous class. It is somewhat difficult to know exactly how much interest a community is going to take in a prospectors' class. Where there is no local excitement, due to discovery or speculation, but few persons may avail themselves of the instruction, even if the same is gratuitous. This was seen to be the case at Sudbury, where, although 31 attended the classes in the aggregate, the average and constant attendance was small. At Sault Ste. Marie the smallest class in the west assembled in 1895, but this year I had there the largest both in point of general numbers and constant attendance. This was due to the discovery of gold in Michipicoton and the general local interest displayed in the same. The total attendance at Rat Portage numbered 61, and the class at Port Arthur 33, the total attendance in the four classes being 192. I must acknowledge the kindness of Mr. Connor at Rat Portage, Mr. Burk at Port Arthur, the school board at Sudbury, and the trustees of the Mechanics' Institute library at Sault Ste. Marie, in placing rooms at the disposal of the class.

Interest in the work.

'Regarding the general benefit of these classes, the result of my experience would indicate to me that theoretical teaching of classes of this sort is not of much use to prospectors, but that practical benefit in sampling and field-testing and determination is derived from them.'

The experiment of keeping the mining laboratory open all summer was not an unqualified success, and I cannot advise a repetition of the experiment. During the year since my last report 13 lots of ore have been tested and there are now on hand awaiting treatment three lots. The Professor of Mining Engineering reports fully on this subject.

Mineralogy and Assaying.

Prof. Nicol's report.

Prof. Nicol reports: 'The illustrative specimens, models, etc., in the lecture-cabinet have been materially increased as the result of my sojourn in Europe. Two cases still remain to be unpacked and a case of fine specimens valued at $100 is waiting in Freiberg till I can send over Canadian specimens in exchange for them. The general collection has been considerably increased from various sources.

'A new feature of the work was a short course of evening lectures, illustrated by lantern slides, to supplement the regular day lectures. About 100 lantern slides have been secured for future use, and it is my intention to increase the stock during the summer holidays, so as to be prepared for a regular course of evening lectures next session.

'The cabinet for museum specimens used for the work in descriptive mineralogy is almost full, so that provision must be made for growth in this direction. It is very desirable that cabinets should be provided for collections of minerals arranged according to the metal constituent, e.g., gold, silver, lead, copper, nickel and iron ores. These would be very convenient for the lectures in chemistry, ores, and ore deposits, and particularly useful for work in the prospectors' classes, which have now become quite an important feature of the school.

'An urgent need in this department is a projection apparatus provided with large Nicol prisms so that the optical properties of minerals may be illustrated to all the members of the class at one time. In this way time and energy may be saved. A suitable instrument can be procured for about $250.

'The working plant in the assaying laboratory has been increased by a convenient apparatus for the electrolytic assay of copper ores, by means of storage batteries charged from the city current.

'The balance room is inconveniently small for good work with our prospectors' class. It is very desirable that it be enlarged and another pulp-balance be ordered. A second muller, too, for grinding ore would be a great convenience, and would prevent crowding and loss of time.

'Twenty-four new places have been arranged in the blowpipe laboratory, so that now there is accommodation for 48 students, working 24 at a time. There is urgent need that some provision be made for artificial ventilation.'

Geology and Petrography.

Prof. Miller's report.

Prof. Miller reports: 'While the more theoretical side of Geology is not neglected, still it is recognized that the chief object sought in establishing the School was the development of the latent mineral resources of the Province. Keeping this object in view, the different courses—elements of Geology, Petrography, etc.—are made to fit into and supplement one another, and to lead up to what is the highest and most important branch of the subject for a technical institution such as this one, namely, economic or applied geology. The attention of students is directed to problems the solution of which would have an important bearing on the development of the resources of the Province. While it is recognized that certain parts of the subject are best studied in the class-room or laboratory, it is evident that this instruction should be supplemented by as much field work as possible. During the fall term considerable time is devoted to excursions. Last autumn a number of such excursions were held and a trip of two days' duration was made by a steamboat down the Rideau Canal, and a part of the interesting

mineral township of North Burgess was examined. The geology of the city suburbs presents considerable variety, which is taken advantage of in the class work.

'Two of the advanced students acted as assistants to the writer during his last season's field work in Eastern Ontario, and they, as well as others, have assisted him very materially in the examination of material and in the compilation of maps, in the preparation of a short report during the past session. A number of students have also been engaged, under the direction of Professor De Kalb, in making a mill test of the corundum rock got out by the writer in November. It is hoped that other material for laboratory and mill tests may be secured during the coming summer, which cannot fail to make the work of the School of a thoroughly practical character.

'That last summer's work has resulted in attracting attention to the mineral resources of the Province and to the School is evident from the notices of it which have appeared in the press, particularly in such technical publications as the Mining and Engineering Journal, New York, and the London, Eng., Mining Journal. Private communications have also been received at the School concerning the subject from persons interested in the mineral industry and living in the United States, England and Germany.

'One of the most interesting classes in geology during the last and other sessions was that of the prospectors, which is held annually during January and February. If the School has one distinguishing feature in connection with its work, it is in the opportunities it offers to men to come here and take a short course at the time of year most convenient for them.

'At present and for years to come there will be work in this country for mining pioneers. By far the greater part of the Province, and the part about which so little is yet known, offers opportunities for the prospector and explorer. Hence I consider the short courses which the School offers the most important for the country in its present stage of development, and moreover the work of the School along these lines may be said to be almost unique.

'The equipment of the Petrographical laboratory, which was begun two or three years ago, has been only partly completed. The equipment should be completed by the beginning of next session, as considerable time was lost and labor exended during last session owing to the means by which work had to be done. The Geological lecture room should be provided with a suitable lantern table and drawers for lantern slides. A few extra cases are required for material which is being constantly added to the collection. The School should be provided with a short focus camera for use in the preparation of lantern slides and in indoor photography generally. Great use can be made of lantern views in the lectures in all the departments.

Equipment required in Geology.

The Mining Laboratory

Professor DeKalb reports: 'The plant and equipment of the Milling Laboratory have been considerably augmented during the past winter by gift and purchase. We are now able to make practical concentration tests upon a large range of products, such as copper, lead, iron and other ores. The gold extraction department of the mill has also been improved by the completion of the cyanide plant.

Prof. De Kalb's report.

'The additions to the laboratory have been the following: 1 inlet discharge hydraulic classifier; 1 vertical line hydraulic separator; 1 3-compartment Hartz jig; 1 buddle; 1 Wetherill magnetic concentrator; 1 centrifugal pump; 1 Sturtevant blower; 1 dust tower; 1 constant-level water-pressure apparatus; 1 gyratory screen shaker; 1 automatic sampler; 1 jig pan; 1 set of 20 brass-wire riddles. Also a considerable number of tools, such as saws, hammers, augers, wrenches, calipers, etc., have been added, enabling many necessary repairs and alterations to be quickly made, without calling on mechanics outside. We are still largely hampered for want of proper tools, however, such as vices, pipe cutters and threaders, and carpenter's tools.

'In addition to the above there have been promised as gifts to the School one pneumatic jig and one gyratory vanner, which will

soon be installed; also a water motor of the Cazin type.

'While our facilities have been appreciably improved during the past year, many new appliances are sorely needed. The object of practical ore-milling instruc ion being to acquaint students with the operation of all the types of crushing, concentrating, and other accessory appliances accepted in the mining world, we must perforce regard our equipment as being incomplete until all these types are represented in our mill.

Plant and equipment needed.

'We are at present deficient in the crushing department of our plant. I would recommend the purchase of improved rolls, with parts easily replaceable, having independent belts for each roll, as a substitute for the old machine. I would also suggest that, as soon as convenient, the following additional crushers be secured: 1 gyratory rock breaker; 1 Sturtevant or cyclone mill; 1 ball mill; 1 sectorator.

'The concentrating plant is deficient in the following particulars: 1 3-compartment Spitzkasten; 1 accelerated jig; 1 side-bump percussion table; 1 end-bump percussion table; 1 round buddle; 1 end-bump screen with replaceable screens; 1 trommel.

'The existing power plant, which is even now inadequate, would have to be supplanted by new boilers and engine. It would be desirable to add boiler and engine rooms to the present structure, and install a 50 h.p. engine and two boilers. In order to afford opportunity for comparative boiler-testing practice on the part of students, it would be well to secure two different types of boilers, the common horizontal flue and the water tube. Plans for all these conditions are now being prepared, in order that estimates may be obtained.

Other Wants of the School

Mr. Mason reports that the drafting room has been, during the past session, filled to its utmost capacity. What is to be done with the larger number which may be expected next session is the problem.

Drafting.

These reports indicate an amount of activity which accounts in part for the over-expenditure noted by the treasurer in his report.

Professor Miller does not overstate the importance of the prospectors' class. The fact that it yearly includes men of such good attainments, many of them actually engaged in mining and prospecting, is a sufficient guarantee of its importance to the country. But the duplication of the classes causes the instructors to be very much overworked. It is therefore to be regretted that the Government has not placed at our disposal the full sum asked for to provide assistants to relieve this pressure. The department of mineralogy and assaying should be the first to be strengthened in this way.

In conclusion, it is necessary to point out that every corner of the Carruthers Science Hall is now occupied, and that there is some need of room for expansion. The time is approaching when no further advance in numbers of students or in equipment can be made without a third building.

I have the honor to be your obedient servant,

W. L. Goodwin, Director.

School of Practical Science.

In the report for 1896 a full description of the assay, blowpipe and chemical laboratories, the milling plant and the collections of minerals, rocks and fossils was given, to which those who may be interested are referred. During the season of 1897-8 a reverberatory roasting furnace and a large muffle and crucible furnace were erected. The cyanide and chlorination plant have also been completed and operated. The equipment of the school for handling Canadian ores in quantities of one or two tons is thus approaching completion.

Equipment of the School.

It must not be forgotten that the academic training of a mining engineer does not lie wholly within the fields of mineralogy and geology, metallurgy and mining. He requires in engineering subjects proper very much the same training as the civil and mechanical engineer. The course in mining engineering in the School of Practical Science owes its strength very largely to the complete equipment of the school in civil and mechanical engineering, of which the portions necessary for the mining engineer are included in the mining course.

The course of training.

The number of students in all courses in attendance during the session 1897-8 was 161, of whom 69 received instruction in the regular classes in mineralogy and geology, mining and metallurgy, 37 of these being regular students in the department of mining engineering. A special class was formed for prospectors which was attended by 15 students.

Attendance of students.

The school was authorized by the Bureau of Mines to carry on a certain amount of work during the summer and autumn of 1897. This work was assigned to Mr. J. W. Bain, Fellow in Mining Engineering, and the following is a copy of the report made by him to the Council of the School :

Mr. Bain's Report to Council.

'At the close of the session of 1896-7, in May, I had the honor of being appointed by you to take charge of the work in the experimental treatment of ores. The following is a report upon the manner in which your instructions were carried out.

Lines of work carried out.

'The work done was of four kinds, viz.:

1. The treatment of large parcels of ore.
2. Work in the museum of the school.
3. Work for the Department of Crown Lands
4. Original work.

'Of these the first was by far the most important, and claimed the largest part of the time. In order that the supply of ores should be ample, steps were taken to make known to persons interested in mining affairs that the school was prepared to treat gold ores in parcels of one and two tons. Advertisements to this effect were inserted for considerable periods in the Globe, Mail and Empire, and World of Toronto, the Sudbury Journal, the Port Arthur Herald, the Wabigoon Star and the Rat Portage News, whilst a circular setting forth the advantages of the mill test for gold ores, and another in reference to the cyanide process, were distributed as widely as possible. As a result six lots were received for the stamp mill, and the concentrates from one of these were treated by cyanidation.

Treatment of ores.

'The first was a parcel of 2,025 lb. from eastern Ontario, which contained a small amount of free gold and some valuable concentrates; the second, 2,000 lb. from western Ontario, was found to be too poor to mill ; the third, 2,000 lb. from eastern Ontario, was poor in free gold, but rich in concentrates; the fourth, 750 lb. from western Ontario, yielded a small amount of free gold, and some concentrates ; from the fifth, 1,140 lb. from western Ontario. there was obtained a handsome amount of free gold and a quantity of rich concentrates ; from the sixth, 1,200 lb. from western Ontario, the returns were much the same as from the fifth. No names or figures are given in this statement, on account of the understanding with the shippers that the results of the tests should be kept private.

'The value of these mill runs to persons who are anxious to obtain reliable data as to the value of a deposit can hardly be overestimated. The error in selecting a ton or more as a representative sample will be very much less than that incurred when only 10 lb. is to be taken for the same purpose, and the partial elimination of the error in sample is a desideratum of no small importance. The difference between the results given by a mill run and those obtained from the assay of small samples is strikingly illustrated if the ore to be treated carry any considerable quantity of free gold. In such a case the results of the assays will vary among themselves, and it is not easy to arrive at the value of the lot, but when the ore is milled this difficulty is obviated almost entirely and a close approximation to the truth is obtained. During the test, valuable data in regard to the economic working of the ore are acquired. The amount of free gold which is arrested by the amalgamated plates is an important factor in the treatment of most auriferous ores, and it is hard to devise apparatus on laboratory scale which will yield results strictly comparable with those obtained in the stamp mill. The concentrates, possessing a considerable degree of purity, are carefully collected, dried and their value ascertained ; if it is desired, the percentage of extraction by chlorination or cyanidation can be determined. Again, assays of the tailings often give valuable information, pointing, for example, to the prejudicial results attending the use of too fine or too

coarse a screen. Illustrations of the points just stated could readily be given from the results of the summer's work, and these demonstrate most emphatically the value of the tests.

'Closely related to the mill run is the testing of an ore, which, for some reason, is not desirable to stamp. This is carried out by crushing the material with a rock breaker and selecting carefully a set of samples which are assayed. Three such tests were made.

'To sum up : Of the eight parcels received, five were treated in the stamp mill, three were tested by sampling, and some concentrates were subjected to the cyanide process.

'Work in the Museum was done during the first part of the summer, and consisted in the arrangment and labelling of the ores and some of the rocks and fossils. The collection of gold ores is of fair size, and specimens from nearly all the Ontario mines are on view. The same may be said of the iron ores.

Work in the Museum

'During July I received instructions to proceed to the Hamilton blast furnace and take samples of iron ores mined in Ontario, under section 1 of the regulations to govern payments out of the Iron Mining Fund. Assays were made and the results reported. In September I was sent to Coboconk to report on some properties in the district. Three days were spent in examining different locations and in giving information. A complete set of samples were taken and assayed on my return. From the results a report was prepared and sent in. In September two half days were spent in setting up and taking down the exhibit of minerals belonging to the Bureau of Mines. There was but little time for original work, and what was done was carried out with a view to the advancement of the metallurgy of gold. J. Watson Bain.'

Work for the Bureau of Mines

Mr. Bain is at present conducting summer schools in mineralogy in the Port Arthur, Rat Portage and Seine River mining districts.

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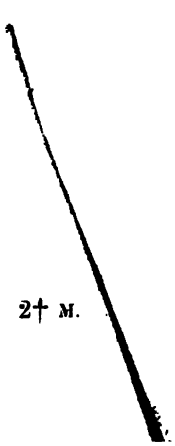

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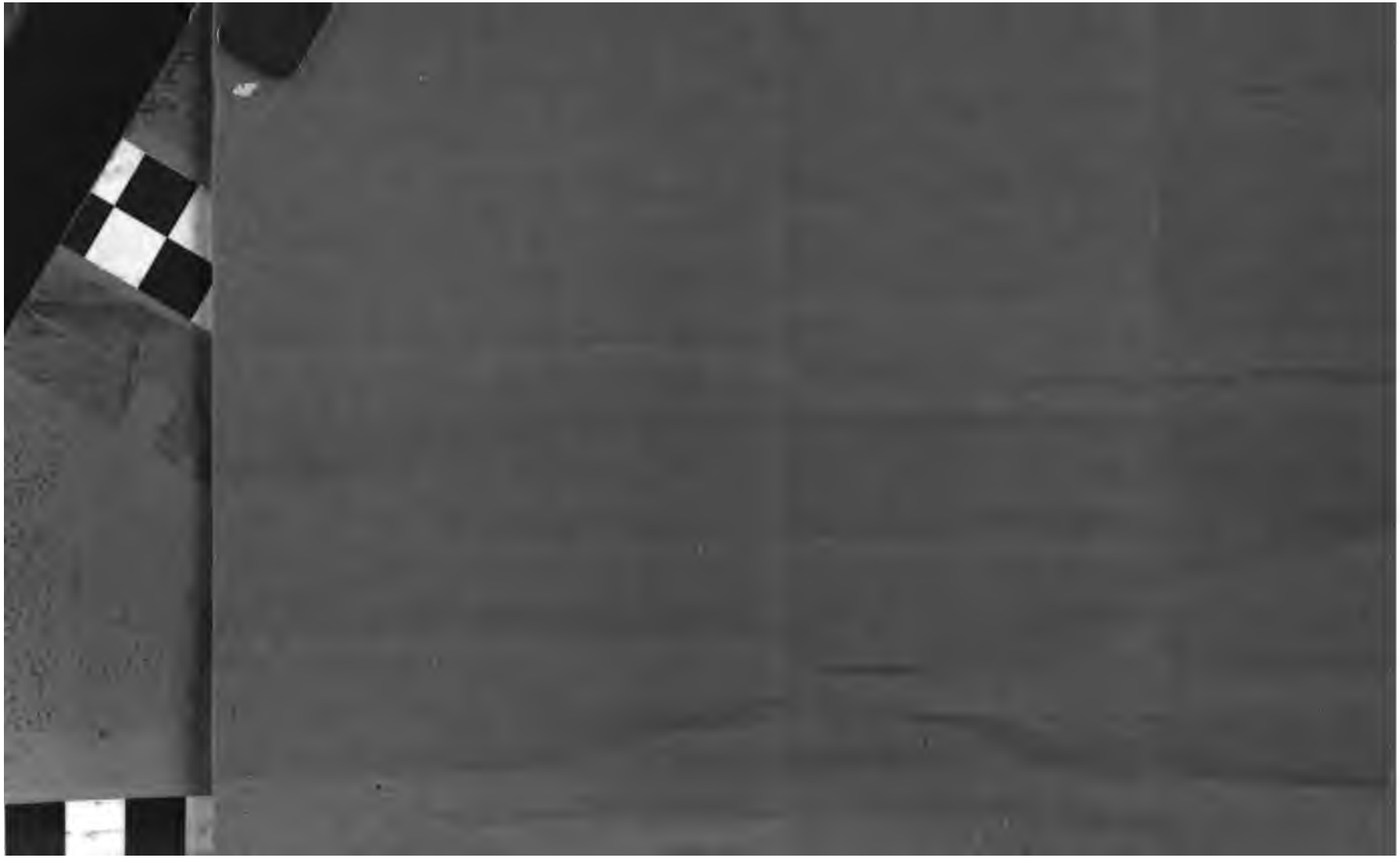

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